WATER WORKS AND SEWERAGE

June, 1934 — Vol. LXXXI. No. 6

The 90½ Inch Wrought Iron Aqueduct Crossing High Bridge above the Hudson River in New York City; Nearing Completion in 1861 to Bring in the Croton Supply. See Article this Issue, by W. W. Brush

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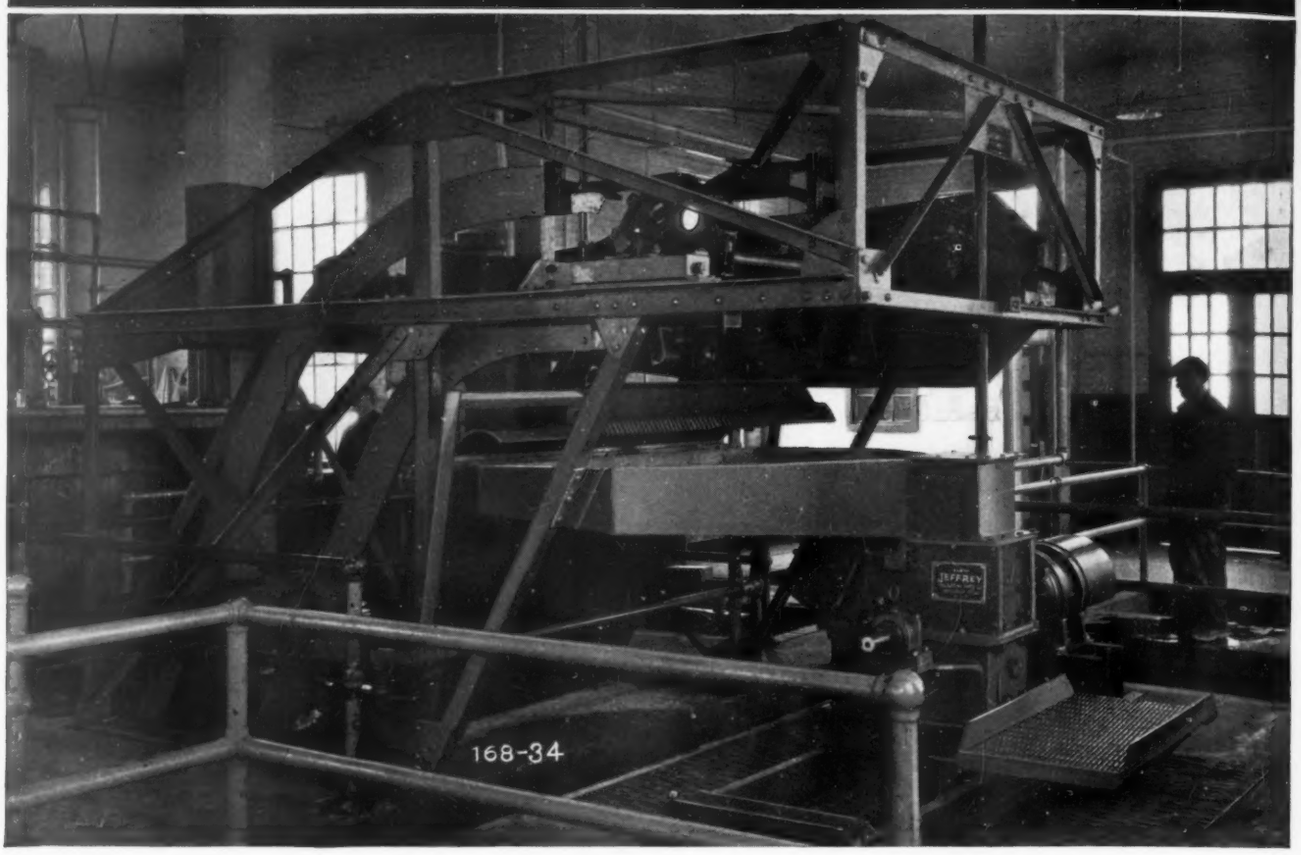
The Utilization of Sewage
A New Method of Sludge Drying
Reconditioning Large Water Mains
Meter Shop Practice and Inspection Program
Features of the New Water Purification Works at Burnt Mills, Md.



JEFFREY Screen and Grinder

The Only Positive Method of Sewage Screenings Disposal

Illustration shows a recent installation of a Jeffrey Self-cleaning Bar Screen (Patent Pending) and a Jeffrey Screenings Grinder. The improved Jeffrey mechanically-cleaned Screen embodies safety features not found in other screens and is the result of many years of development.

You can forget Screening troubles with this new type Screen . . . a special hinged scraper prevents jamming of the mechanism from the accumulation of foreign objects such as bricks, water-soaked logs, etc.

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The Jeffrey Grinder actually reduces the screenings to a pulp (it does not tear it into long strings or strips that will eventually clog the pumps) which passes readily through the pumps and sinks into the settling tanks. Where the sludge is filtered the addition of the pulped screenings materially increases the efficiency of the filters.

The particular installation shown here is handling an average flow of 16 to 20 million gallons per day.

A Jeffrey Sanitary Engineer is at your disposal . . he will be glad to look over your plant and submit recommendations . . without obligation.

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WATER WORKS & SEWERAGE

L. H. ENSLOW, Editor

LEADING ARTICLES To Appear in the Next and Subsequent Issues:

C. H. Capen, Consulting Engineer, West Orange, N. J., will analyse fire protection charges made by Water Companies as compared to those, (if any) allowed Water Departments by municipalities. In this he will show the unfairness to Water Departments by citing case records covering both of these classes of important water supplies in New Jersey.

An article by Reeves J. Newsom, President, Community Water Service Co., New York, will tell of experiences in "Thawing of Frozen Service Pipes" and the best known practices in this troublesome but important service.

J. R. Rumsey, Superintendent, Sewage Treatment Works, Grand Rapids, Mich., will report on experiences with gas engines operated on sludge gas, resulting from a study of this method of converting this by-product of sewage treatment into power.

W. L. Eisert, Manager, Riverton (Pa.) Water Company, in an article on "Advertising" recounts successful methods of building consumer and community good will for the local water utility.

A. S. Behrman, Chemical Director, International Filter Company, is to relate and discuss "Recent Developments in Municipal Water Softening."

J. E. Herring, Manager of Meter Department, Jacksonville (Fla.) Water Department, will tell of methods employed in the operation of this Department; describe field and shop practices in maintenance, testing and repairing.

John A. Carollo, of Headman and Ferguson, Engrs., Phoenix, Ariz., will relate simplified methods, of "Determining Loss of Capacity and Deterioration of Water Mains," which have proven of practical value without interruption of service or costly preparation.

L. F. Warrick, Chief Engineer, of the State Board of Health of Wisconsin, will contribute two articles dealing with industrial waste treatment. These will describe successful methods of "Treating Milk Wastes" and "Treating Canning Wastes" which have been developed and adopted in Wisconsin as the most practical available processes of treatment of such wastes.

Professor Eric Therkelsen, Head of Mechanical Engineering Dept., at the University of Montana, will contribute two articles discussing, first, the "Fundamentals of Fluid Flow"; next, the "Principles of the Centrifugal Pump." These are based on lectures given before the Montana Water Works Short School.

E. T. Killam, Consulting Engineer, New York City, will analyse and evaluate the influence and effects of "Variations in Hourly Loadings, as a Factor in Operation of Sewage Treatment Plants," offering some suggestions of operating program to compensate for such variations.

John R. Baylis, will continue his discussion of "Filtering Materials for Rapid Filters"—Methods of testing and specifications will be suggested.

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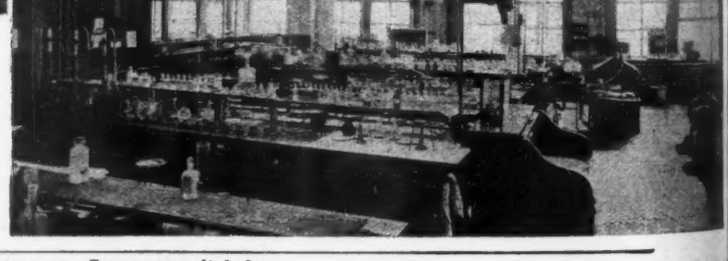
Piedmont, W. Va. plant where we make several hundred thousand pounds of Aqua Nuchar monthly. T. W. Strohm, Supt.

Covington, Va. new plant. D S. Troubs, Supt.



Research Laboratory

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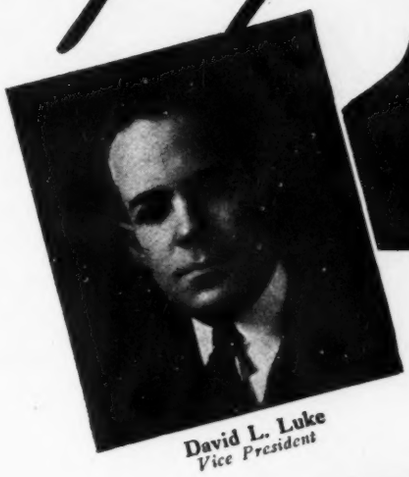
the Bogey



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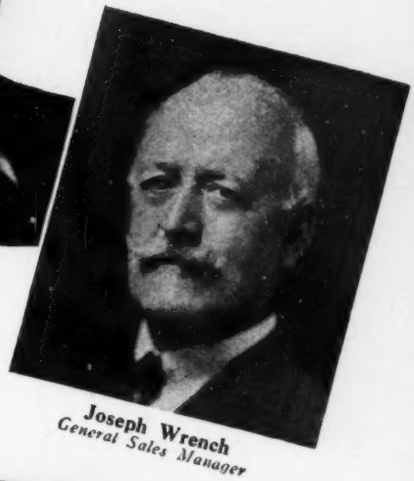

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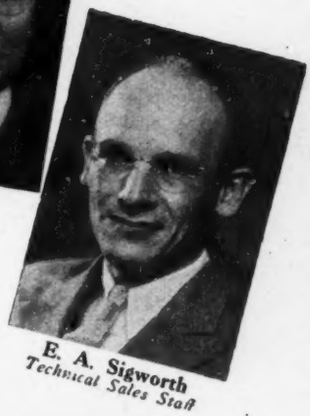

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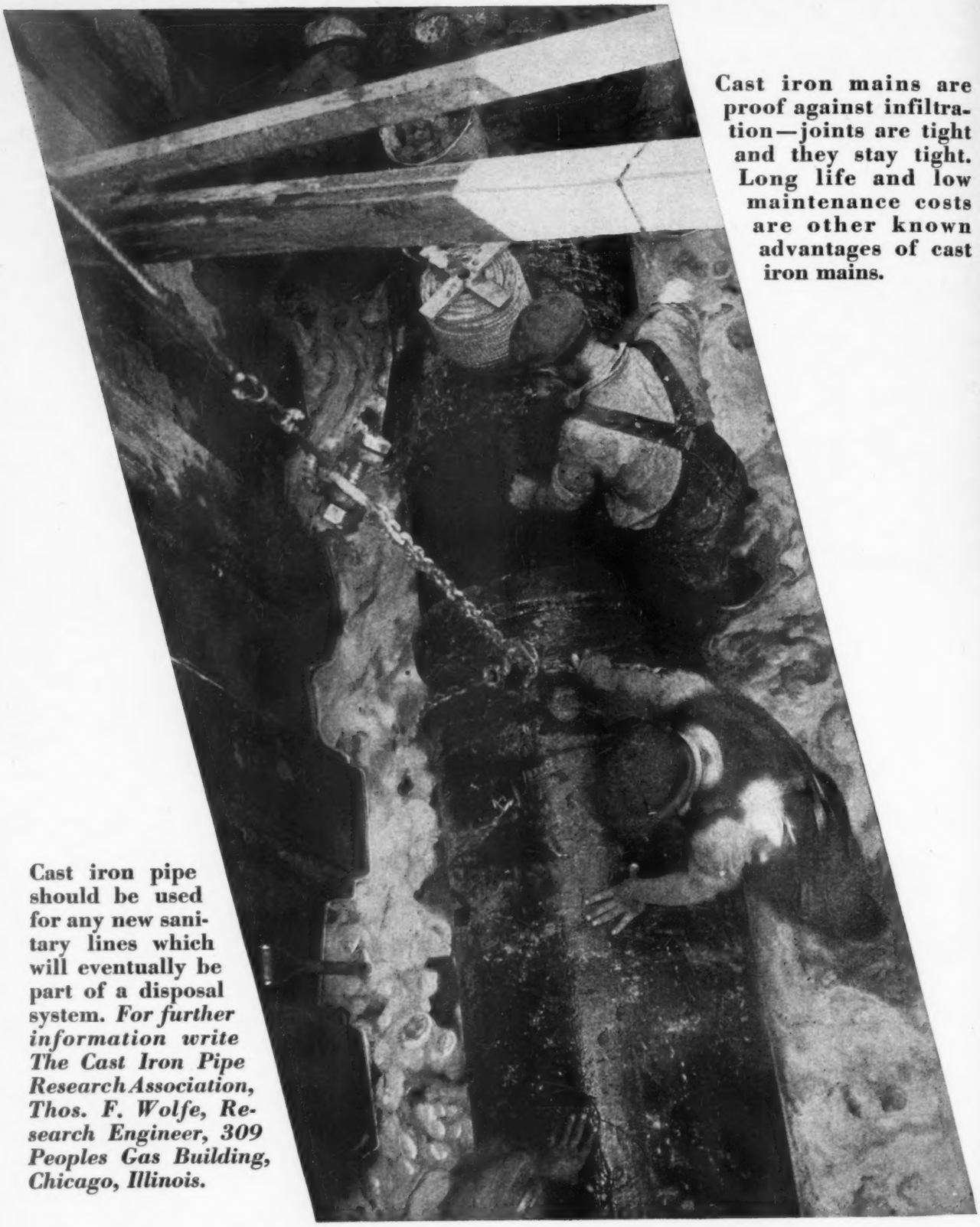

Cast iron mains are proof against infiltration—joints are tight and they stay tight. Long life and low maintenance costs are other known advantages of cast iron mains.

Cast iron pipe should be used for any new sanitary lines which will eventually be part of a disposal system. ***For further information write The Cast Iron Pipe Research Association, Thos. F. Wolfe, Research Engineer, 309 Peoples Gas Building, Chicago, Illinois.***

with infiltration-proof joints

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Water Department at Racine, Wisconsin, relies on Mathieson Chlorine and HTH

●*Chlorinating equipment of Racine Water Department, where Mathieson Liquid Chlorine is used.*

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Mathieson Liquid Chlorine is the consistent choice of leaders in the field of water purification who look beyond ordinary standards to the sense of responsibility of the maker. They find this responsibility reflected in every pound of product—in every cylinder—in every response to a call for service.

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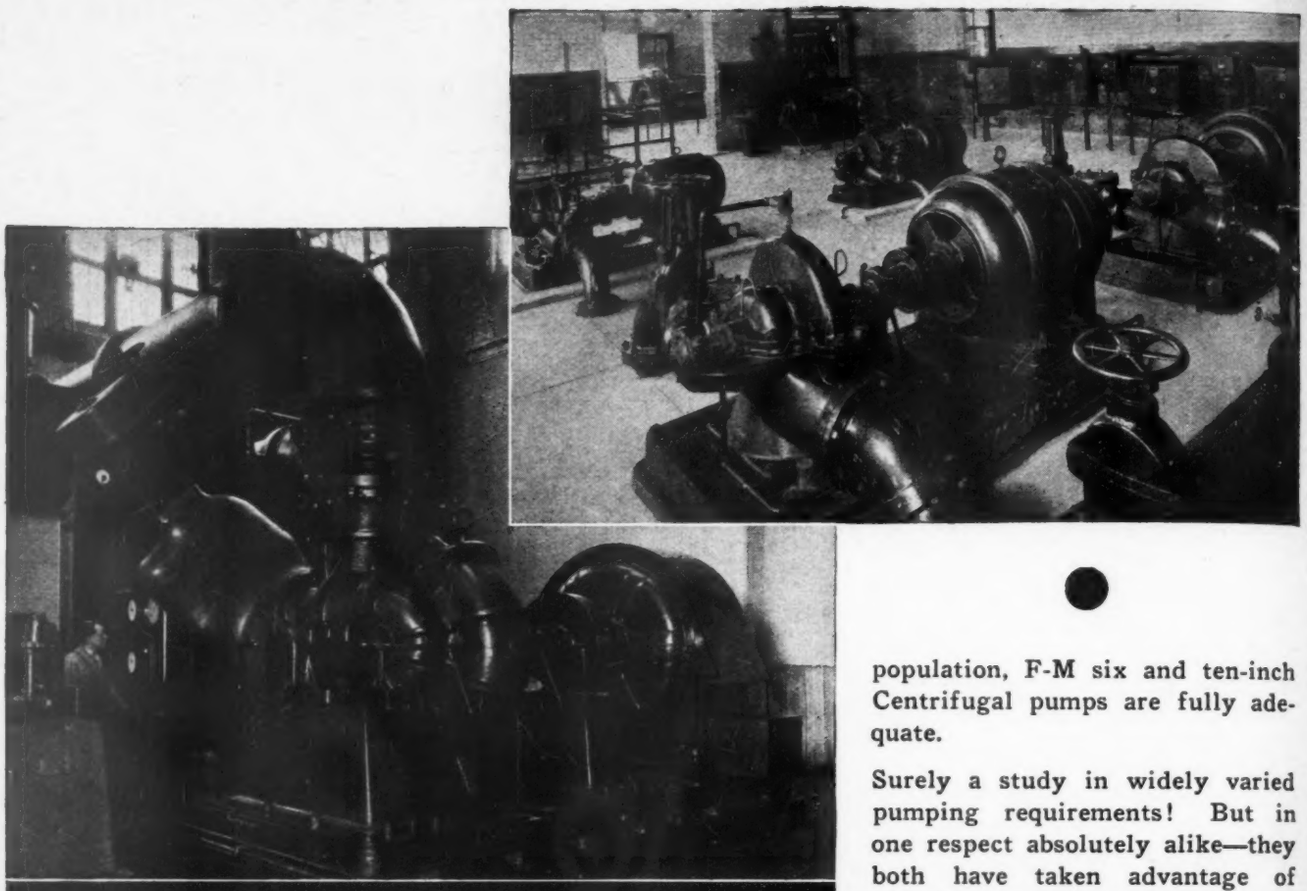

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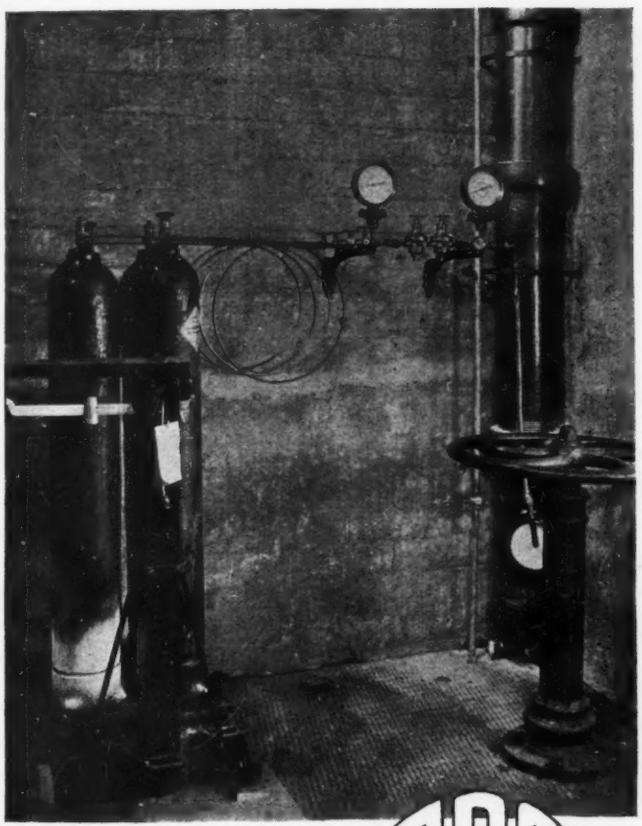

And as we carry on, keeping pace with progress, we take this opportunity to thank the many public officials and public-spirited citizens whose foresight and cooperation have made our efforts bear fruit. To these men, we pledge anew our guarantee of continued high quality in our product; and we extend to them the services of our entire technical staff—a staff ready at all times to aid in the betterment of public health conditions.

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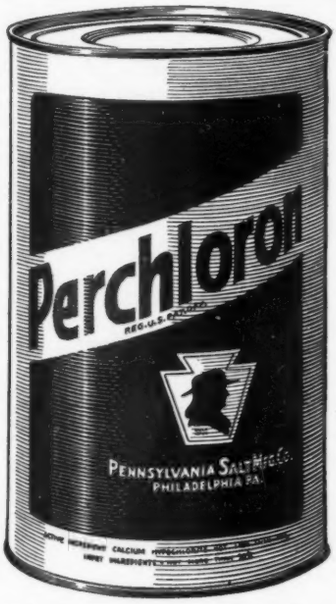

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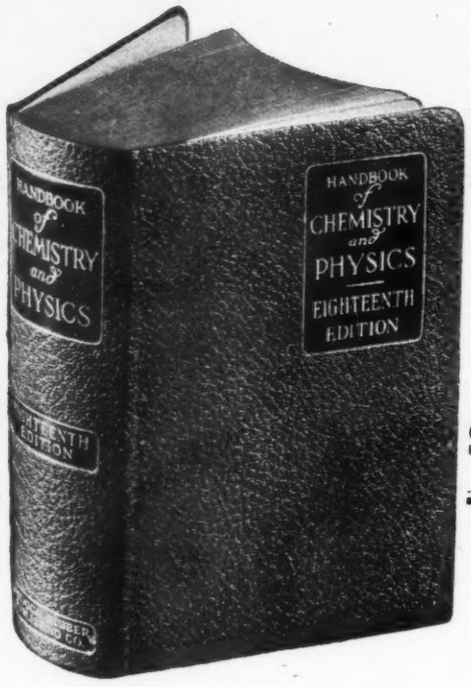

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With this total of 11 years of service "U. S." Ferric Chloride Permobond has conclusively proven its superiority. *It has been subjected to longer service than any other rubber lining.*

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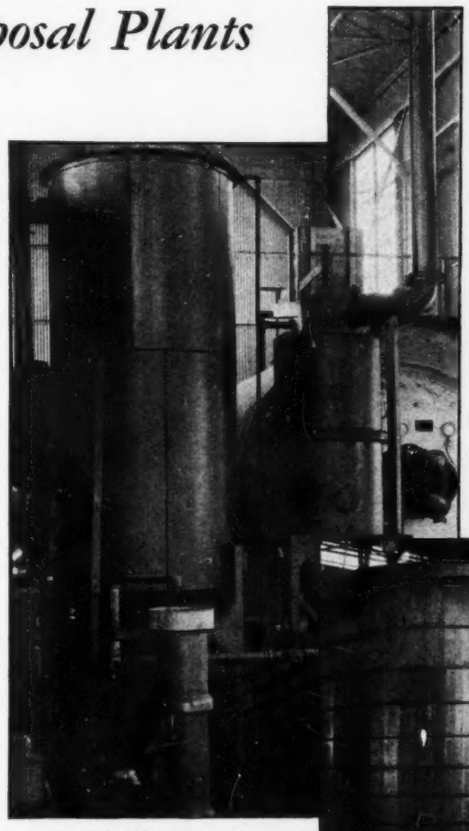
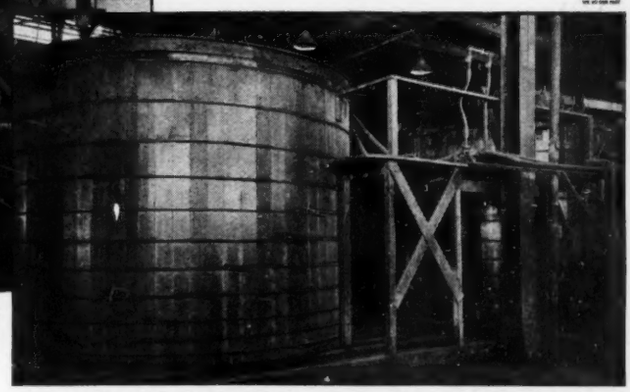
"U. S." Engineers will welcome the opportunity to cooperate with you in solving your Ferric Chloride problems. A phone call or letter will bring a representative without obligation.



Ferric Chloride tanks and piping at the Stickney plant of the Chicago Sanitary District are lined with U. S. Ferric Chloride Permobond.



These 12,000 gallon Ferric Chloride storage tanks at the Milwaukee Sewage Disposal Plant, measure 11 feet in diameter by 10 feet, 6 inches in height. Both are lined with "U. S." Ferric Chloride Permobond.

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*CHLOR-O-FEEDER is corrosion-proof for feeding all forms of hypo-chlorite solutions; HTH; Perchloron; Merchlor; sodium hypochlorite.

Designed by the originators of FERR-O-FEEDER—the ferric chloride pump for sewage treatment pH control—and designers of TRET-O-CONTROL equipped flow-responsive dry feeders.

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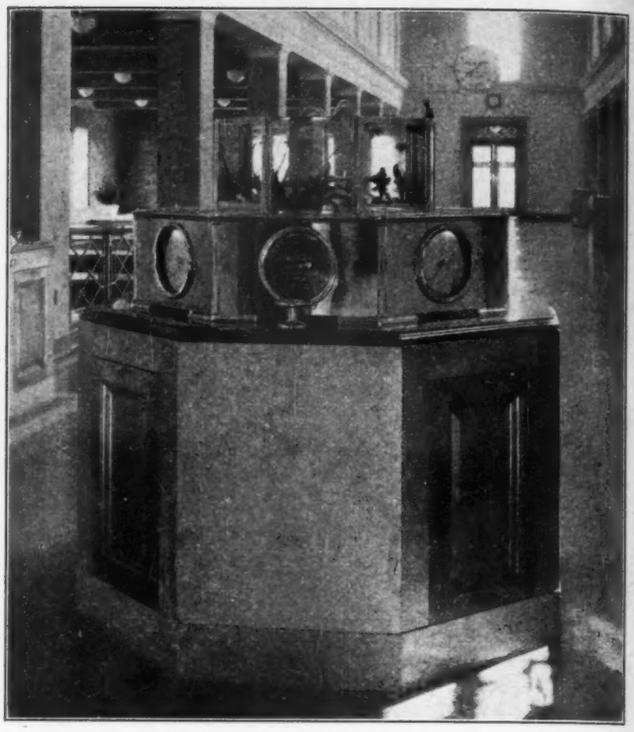
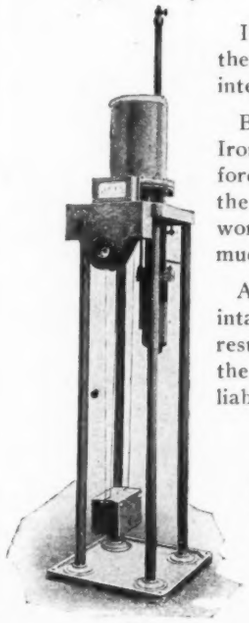


Master Operating Table, Lancaster, Pa., Filtration Plant
The Chester Engineers, Designers, Pittsburgh, Pa.
American Water Softener Company, Contractors, Philadelphia

Proud of our past?

Yes, but twice as proud of our present, which means much more to you!



1893
Original Venturi Register used with Venturi Meter Tube No. 1

If we had made the first Venturi and then stopped, to you it would be just an interesting historical fact.

But, because since that date Builders Iron Foundry has been constantly in the forefront of engineering developments in the metering and controlling in the water works and sewerage field, our age means much.

Age in our case, then, has given us that intangible but real **"know how"** and has resulted in a line of equipment which has the characteristics of practicability, reliability, and accuracy which you need.

You are cordially invited to drop in at our booth at the New York A.W.W.A. Convention. Our exhibition will interest you, we believe.

VENTURI

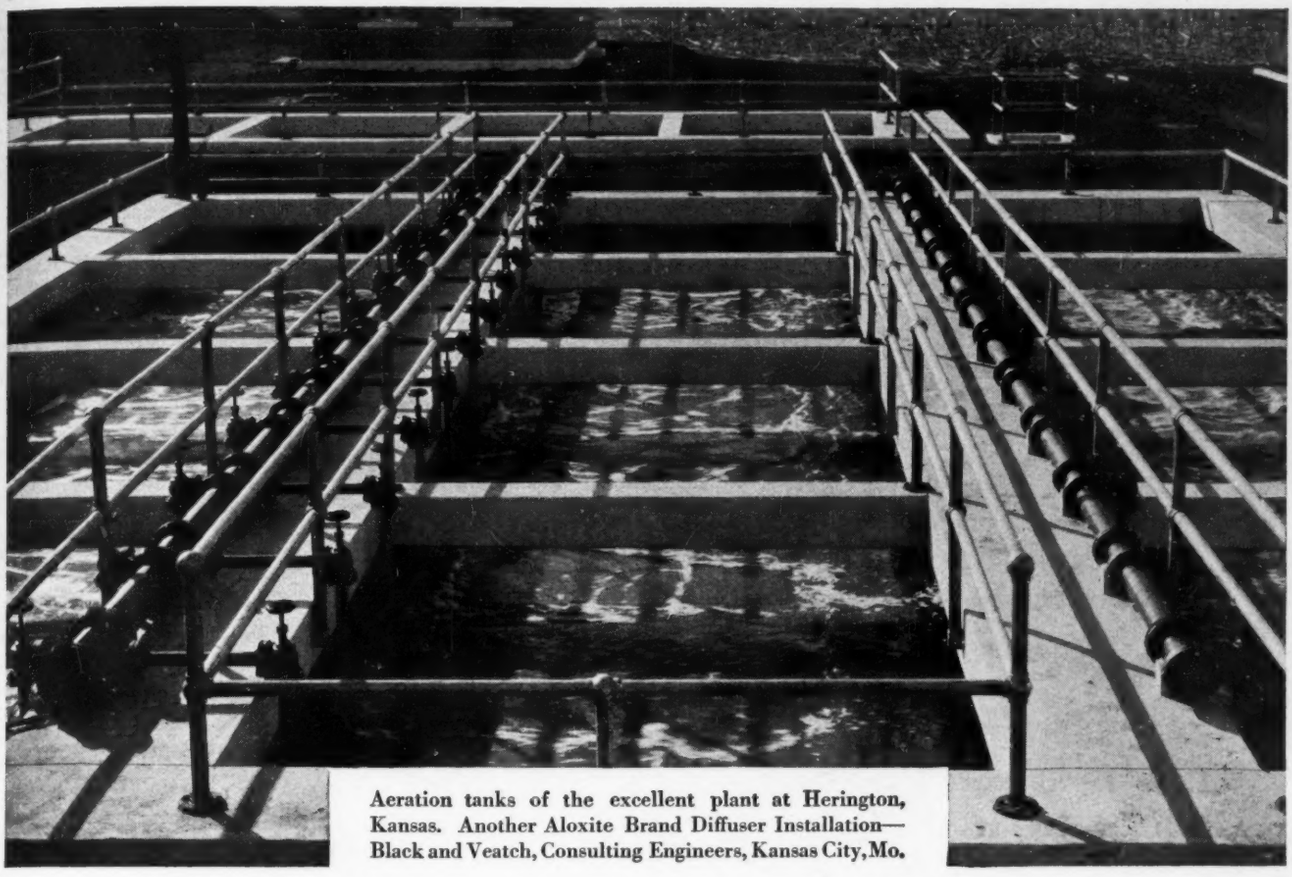
"VENTURI" Registered

Builders Iron Foundry

"Builders of the Venturi Since 1891"

9 Codding Street **Providence, R. I.**

FORCEFUL FACTS ON SEWAGE AERATION BY DIFFUSED AIR—No. 3 (Cont.)



Aeration tanks of the excellent plant at Herington, Kansas. Another Aloxite Brand Diffuser Installation—Black and Veatch, Consulting Engineers, Kansas City, Mo.

Again we stress this fact . . .

—Maximum values in sewage are best recovered by activated sludge treatment

THE water in sewage is most efficiently reclaimed by activated sludge treatment—for boiler or other industrial water supplies—park, garden or farm irrigation—fish hatcheries—lagoons—even for replenishment of public ground water supplies.

The highly stabilized and clear effluent from the Herington plant—softer than fresh ground water supplies—is sold to the Rock Island Railroad, which uses it for locomotive boilers and other round house uses. An appreciable saving for the railroad and a real benefit to Herington taxpayers. An outstanding example of Forceful Fact No. 3.

Write our Sanitary and Filtration Department for further information, Technical data or Engineering service on any of your aeration problems.

For Efficient Aeration, use

ALOXITE

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BRAND

DIFFUSER MEDIUMS

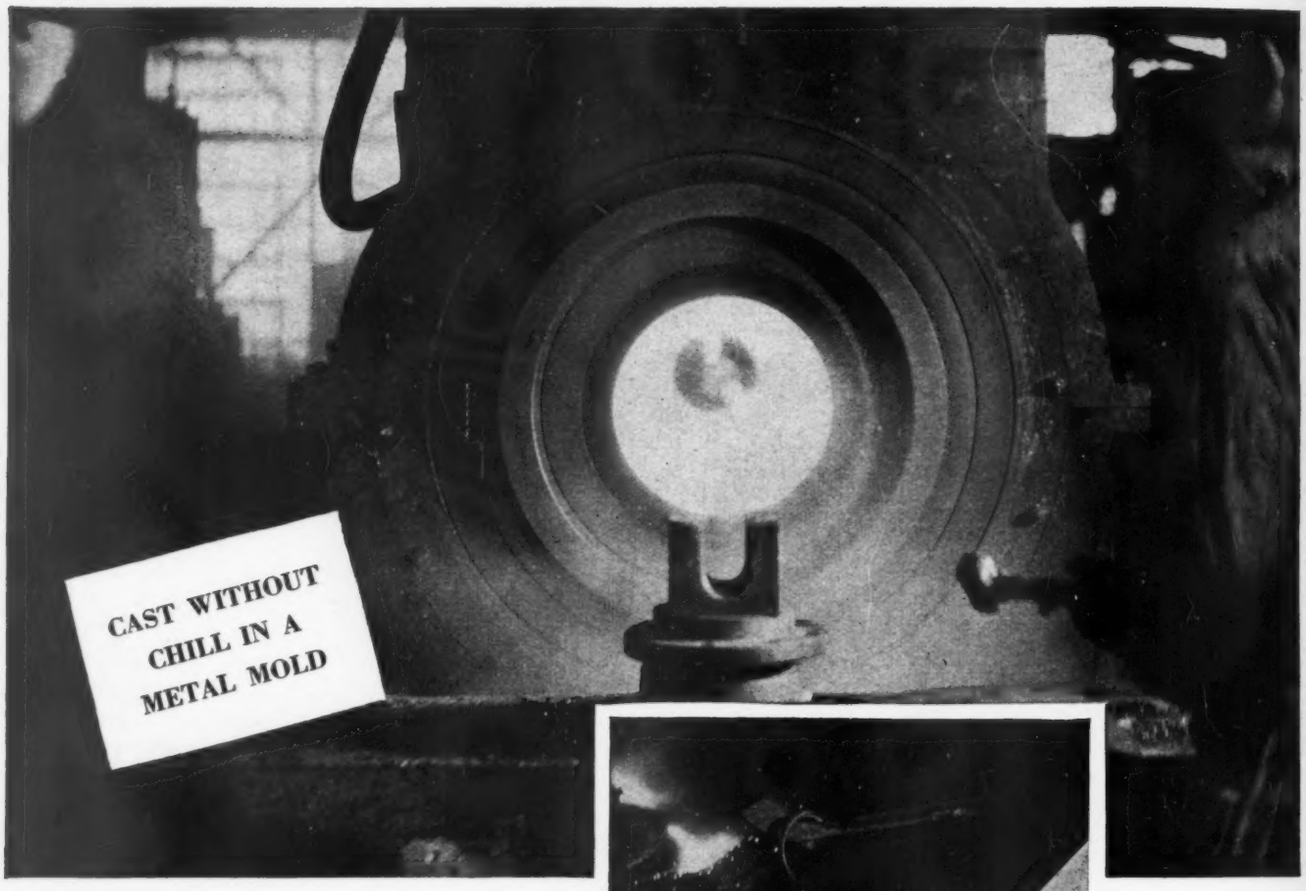
Products of **THE CARBORUNDUM COMPANY** *Niagara Falls, N. Y.*

CANADIAN CARBORUNDUM CO., LTD., NIAGARA FALLS, ONT.

(CARBORUNDUM AND ALOXITE ARE REGISTERED TRADE MARKS OF THE CARBORUNDUM COMPANY)

Yes—we would like you to mention WATER WORKS AND SEWERAGE.

impact strength DOUBLED



A patented improved process of centrifugal casting endows Super-de Lavaud pipe with physical characteristics which make this new pipe radically different from de Lavaud pipe as previously produced. There has been a fundamental metallurgical change in the metal structure. This new pipe is shatter-proofed to the extent that impact-resistance has been increased more than 100 per cent. When tested to destruction by hydrostatic pressure it does not shatter. It is a tougher, more ductile pipe capable of greater deformation without breakage. The factor of protection against handling hazards from plant to underground has been doubled. *Send for descriptive booklet.*

UNITED STATES PIPE AND FOUNDRY CO.
BURLINGTON, N. J.
Foundries and Sales Offices throughout the United States

Two years ago our research and technical staffs found a way to accomplish the "impossible." Super-de Lavaud Pipe is cast without chill in a metal mold. The product of this revolutionary process is an unchilled gray iron casting with extraordinary impact-resistance. The resultant metal structure fractures *non-directionally* counteracting fragmentation and permits a new annealing technique still further increasing impact-resistance.

NRA

U.S. SUPER-DE LAVAUD PIPE

WATER WORKS AND SEWERAGE
VOL. 81 NO. 6 JUNE 1934
A GILLETTE PUBLICATION

RECONDITIONING LARGE WATER MAINS

By WILLIAM W. BRUSH

Chief Engineer of Water Supply, Department of Water Supply, Gas and Electricity, City of New York.

IN the water supply system of the City of New York there are 1,298,000 feet of 30 inch to 60 inch cast-iron mains, the oldest of which were laid approximately ninety years ago. There is a 90 inch wrought-iron conduit that is seventy years old, and there are 365,000 feet of steel mains from 30 to 72 inches in diameter, the oldest of the steel mains being laid in 1896. The cast iron pipe has generally been coated with the ordinary coal tar dip, which represents only a very slight protection against corrosion. The wrought-iron conduit was originally coated with two coats of metallic paint, but this proved of little value as a protection from corrosion. The majority of the steel pipes have been coated with an asphalt dip, and coal tar enamel, hand applied, has been used for some of these pipe lines.

William W. Brush.

Need of Reconditioning Large Mains

The two main sources of water supply for the City of New York are the Croton River, which was first used in 1842, and the Catskill supply from Esopus and Schoharie Creeks, the waters from which were first used in 1917. In the borough of Brooklyn the surface water from the south side of Long Island was first used in 1858, and thereafter up to 1917, the original surface supply being augmented mainly from Long Island's ground water sources. Of these three supplies the Croton is the least active in causing corrosion of iron, and its effect on iron may be judged by the fact that Croton water has not clogged small sized (cold water) iron house piping in less than approximately thirty years. The Brooklyn supply is more corrosive than the Croton supply and causes house piping to clog in about twenty years. The

The author of this article, having served the Department of Water Supply for 40 years, 24 of which he has served as Deputy and then Chief Engineer, has during that time built for himself an international reputation in the water-works field.

One of the most recent programs to be initiated under his direction is that of cleaning and applying protective coatings to large diameter water mains, now in service, as related in this article.

Retiring as Chief Engineer of New York's Department of Water Supply, this month, Mr. Brush will take a long deserved vacation which will include a trip to Europe.

Always an active member of the American Water Works Association, he has served as its President and continues as it Treasurer, an office he has been entrusted with for several years.

We are happy to learn from news articles and editorials in the New York papers that Mr. Brush will retire on a pension allotment which will insure him a comfortable and deserved retirement.—Editor.

Fig. 1—Section of 20 inch pipe laid in the Bronx in 1906, showing tuberculated interior. This line was cleaned at the time of removing the section in 1930.

Catskill water is by far the most active in corroding iron. Small iron house pipe conveying this water has a useful life of but ten to fifteen years, approximately.

Experiences With Cast-Iron: The interior of cast-iron pipes after being in contact with the Croton water for some fifty years, is generally coated with iron rust tubercles about an inch in height, and the carrying capacity of these pipes has thereby been reduced by about one-third. With the Brooklyn water, in approximately thirty years, the interior of the pipes are covered with similar rust tubercles to those found in the Croton pipes. With the Catskill water a similar condition is estimated to be found in approximately twenty years. Figure 1 shows a section of 20 inch pipe that was laid in 1906 in the borough of the Bronx, which carried Croton water up to 1917, and since that date Catskill water or a mixture of Croton and Catskill water. In 1930 this pipe was cleaned with a pipe cleaning machine, the Williams and Hazen pipe coefficient being 78 before cleaning, and 137 after cleaning, the flow in the pipe before and after cleaning being determined by pitometer measurements. The effect of tuberculation on smaller pipe in the Brooklyn system is strikingly shown in Fig. 2, where cross sections of two 6 inch pipe are shown. The badly tuberculated pipe was laid about 1858, and the pipe showing practically no tuberculation was laid in about 1863, both of the pipes being removed in 1925. The untuberculated pipe represents a very unusual condition resulting probably from a relatively thick coal tar protecting coating on the interior of the pipe. Generally, the small Brooklyn pipes laid about seventy years ago are in the condition of the badly tuberculated pipe. These pipes at times show a coefficient in the Williams and Hazen formula of below 20. The amount of material that is removed from one of these old pipes is illustrated by Fig. 3, which pictures the pile of iron oxide removed from only 850 feet of 8 inch pipe. It is evident that for both large and small cast-iron pipe the removal of the iron oxide incrustation is necessary if the mains are to be restored to approximately their original carrying capacity.

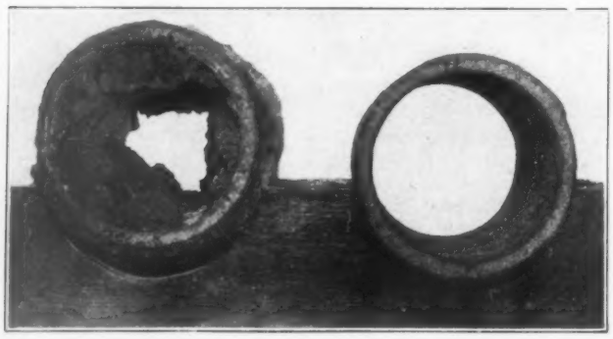


Fig. 2—Sections of 6 inch pipe removed from the Brooklyn distribution system in 1925. The tuberculated pipe is Scotch pipe, laid about 1858, and is typical of the small pipe laid in Brooklyn fifty or more years ago. The untuberculated pipe was laid in 1863. The better protective coating apparently responsible for its preservation against attack.

Experiences With Wrought-Iron: A 90 inch wrought-iron pipe was laid on High Bridge as part of the old Croton Aqueduct, this pipe being installed in 1861. The pipe was made of one-half inch riveted plate. The oxidization of the metal has caused rust tubercles from one-half of an inch to an inch and a half in height to be formed. Under some of these large tubercles the pipe thickness has been reduced to one-eighth of an inch, but apparently on the average only about one thirty-second of an inch of the metal has been destroyed by the attack. As this pipe does not carry water under any appreciable head, the Department planned to clean the approximate 1400 feet of this 90 inch pipe and to install a reinforced cement mortar lining, at an estimated cost of $15,000. The carrying out of this work has, however, been delayed on account of financial conditions. Fig. 4 shows the interior of this wrought-iron pipe. The construction picture (1861) of its crossing of the Harlem River on High Bridge appears on the front cover of this issue.

Fig. 3—Pipe cleaner and 3½ cubic yards of incrustation removed from 850 feet of 8 inch pipe in the Brooklyn system.

Experiences With Steel: For the steel pipe, it has been found that where an asphalt dip is used the tuberculation of the pipe has proceeded at a rate which indicates the desirability of cleaning and recoating the pipe after some twenty to thirty years of use. A 72 inch steel

pipe was laid on Long Island between Brooklyn and the Suffolk County Line, a portion of this pipe being installed in 1903, and another section in 1907. This pipe was given a dip coat of asphalt. The condition of the interior of this pipe is shown in Fig. 5. This pipe is made up of 5/8th inch plate with riveted joints, and in a test made in 1930 on 41,000 feet of the pipe the coefficient C in the Williams and Hazen formula was found to be 94. While generally the tuberculation has not progressed to a point that seriously threatens the life of the pipe, there have been one or two spots where apparently the attack by corrosion extended through the wall of the pipe. Generally, the condition of the pipe is such that the cleaning and recoating of it at the present time is indicated more definitely on the basis of carrying capacity than on the basis of likelihood that the pipe would be seriously injured if the recoating were delayed for several years. Other steel pipes that were coated with asphalt dip and exposed to Catskill water, indicate that cleaning and recoating is desirable at the end of twenty years of use. With the pipes efficiently coated with a coal tar enamel, the indications are that no cleaning or recoating of the pipe would be needed for a considerably longer period.

The situation as to the need of recoating the pipes forming the distribution system of the City of New York may be summarized as follows: Practically all of the pipes that have been in use for twenty years or more, not having received what may be termed a heavy protective coal tar coating, are in condition where the reduction of carrying capacity makes it advisable to restore the original carrying capacity, if such restoration can be accomplished at a reasonable cost. Further, in the case of the steel pipes coated with asphalt, the cleaning and recoating of these pipes is very desirable for the purpose of extending indefinitely the useful life of such pipes.

Cleaning and Reconditioning Iron Pipes

About three years ago a section of 72 inch (Long Island) steel pipe was cleaned and recoated, using a coal tar enamel. This work was done in an experimental way. It was found that sand blasting entirely removed the old coating and gave a thoroughly clean gray steel surface upon which to apply the new coating. Also, scraping followed by the use of wire brushes on the pipe produced a surface that was believed to be satisfactory for the application of the new coating. When the recoated section was examined a short time ago, after about three years of service, the coating was in practically perfect condition and there did not appear to be any appreciable difference in the portion where the sand blasting had been used, as compared with the portion where the pipe was cleaned by scraping and brushing. While the cost of cleaning and recoating the interior of the large pipes can only be determined after this work has been undertaken on a large scale, a figure of approximately 20 cents per square foot of pipe surface may be considered an approximation of the cost of this preparation.

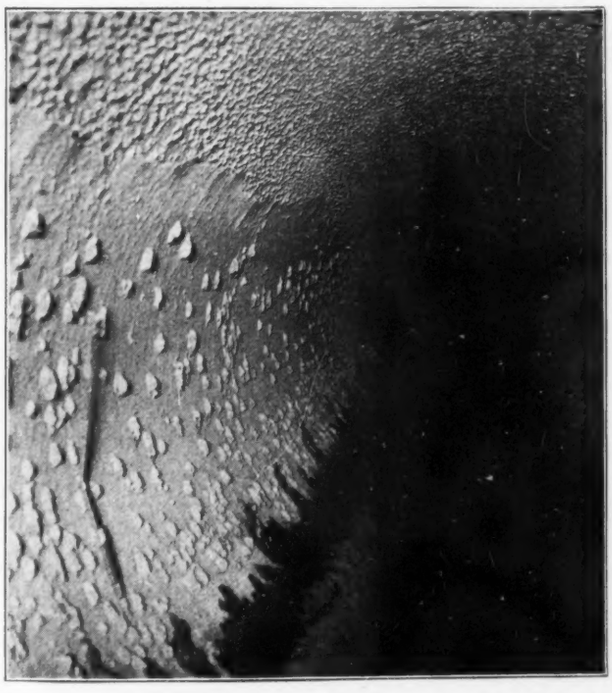


Fig. 4—Interior of 90 inch wrought-iron pipe on High Bridge. Installed 1861 to bring in Croton water. To be cleaned and lined after more than 70 years of service.

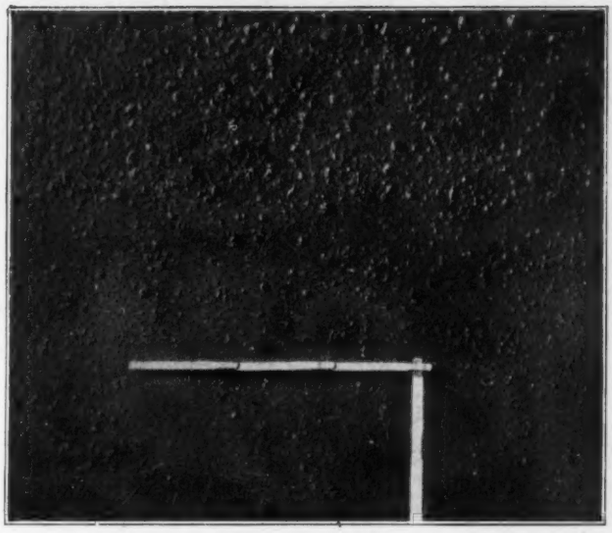


Fig. 5—Interior view of 72 inch steel pipe after about 23 years of service on Long Island. Even such tuberculation justifies cleaning and lining to restore carrying capacity.

Cement lining offers an interesting possibiilty for the recoating of the pipes that need to be reconditioned. The writer believes that water works engineers and superintendents are at the present time generally of the opinion that both coal tar and cement will effectively protect iron pipe if applied in such a manner as to remain in contact with the metal surface. The cement gun has been successfully used in applying cement mortar to the interior of large pipes, but usually only where a thickness of coating of an inch or more is desired. There has recently been invented a machine to apply cement mortar to the interior of a pipe line by means of a revolving head, the mortar being thrown by centrifugal force against the wall of the pipe. With cement mortar the interior of the surface of the pipe does not need to be dry, whereas with coal tar enamel a dry surface is essential. There exists an enormous field for reconditioning distribution pipes that are used to convey waters that actively cause corrosion, such as those found along our Atlantic seaboard and in the Pacific Northwest in particular. We may therefore expect that those interested in the recoating of pipes will endeavor to develop means of cleaning and recoating pipe in a manner that will be practical, both from the viewpoint of cost and the resultant increase in carrying capacity and length of life of the pipe lines. Both Jersey City and Newark have undertaken some of this work, and in New York it is expected that the work will be carried out when pipe lines can be put out of service for the period necessary to clean and recoat them and as rapidly as the required funds are made available.

METER SHOP PRACTICE AND INSPECTION PROGRAM

By RICHARD H. ELLIS

Water Commissioner,
Newton, Mass.

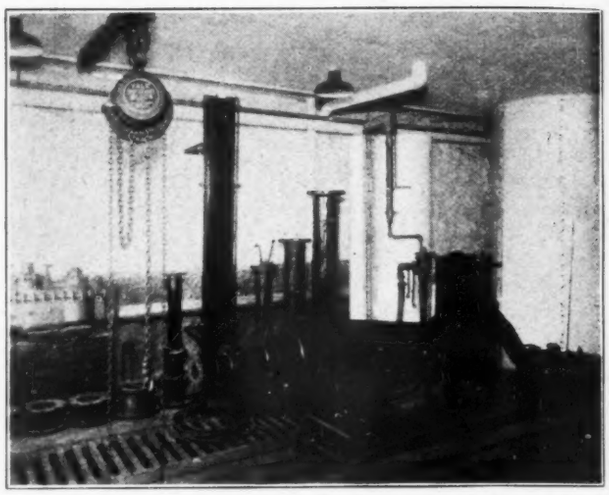
R. H. Ellis

THE yardstick by which a water works sells its product is the water meter. It is as essential to periodically check and if necessary re-establish the accuracy of this measuring device as it would be for a merchandising organization to calibrate the yardstick or scale by which it measures or weighs whatever product it markets.

Too frequently, particularly in municipal plants, do we find that a water meter is assumed to be accurate until it is reported as "slowing up" or "stuck" and without doubt this assumption may, in isolated cases, be correct. The usual occurrence, however, is that long before the meter becomes inoperative it has failed, due to worn discs, chambers, diaphragms, gear trains, etc., to register small streams or to account for 100 per cent of the water drawn at any time and is thus virually cheating the vendor of a percentage of his rightful revenue.

The city of Newton, Mass., having in service some 15,500 meters ranging in size from ⅝ inch to 6 inch, was one of the early cities to become 100 per cent metered. Originally a meter inspector was assigned a certain district and it was his duty, not alone to regularly read the meters in this district but also to keep them in repair. As the several different districts developed, the work of reading the meters took proportionately greater time and the meter repair work suffered more and more until it was found on the last reading for the year 1930 that 5 per cent of the total number of meters were actually stuck. It was evident that considerable revenue was being lost; and, this loss it was felt could be corrected by the establishment of a regular and continuous system of meter inspection and repair.

Meter Test Room, Newton, Mass., Water Department. Note the Light, Roomy Shop, Kept in First Class Order.



Hydraulic Laboratory and Test Room for Large Meters, Newton, Mass., Water Department. Note Equipment for Handling Heavy Meters.

At that time (January, 1931) plans had been developed for the reconstruction of the "Supply Yard Building"—the waterworks shop. This reconstruction offered an opportunity to incorporate therein a meter repair shop of ample proportions, designed to permit the inspection and rebuilding of from 4,000 to 8,000 meters per year. The meter repair room as constructed is 45x45 feet and is equipped with wash trays, lathe, testing equipment for meters up to the 2-inch size, work benches for four workmen (3 only have been employed at any one time to date), hooded acid tanks, storage racks, etc. The work benches are so arranged that each workman has ready access to a sink supplied with hot and cold water, compressed air and gas outlets, motor drills and grinders. Factory gages are provided for the checking of the parts.

All meters larger than the 2-inch size can be tested in a hydraulic laboratory in the basement wherein is provided three calibrated tanks of 1.5, 16.0 and 120 cubic feet capacity. Piezometer rings and a mercury U-tube are used to determine the loss of head, etc. A chain fall suspended from an overhead track facilitates the handling of the large meters to and from the laboratory. A gun carriage type device for quickly connecting up the discharge side of large meters—having adaptors for different size meters—permits the rapid assembly on the test floor.

While there is, unquestionably, merit in the theory that a meter will render satisfactory service until there has been recorded thereon the passage of a certain amount of water it is the writer's opinion that the determination of the maximum permissible registration is dependent on various factors—such as, chemical composition of the water, electrolytic conditions, and the quantity of foreign substance to be encountered. It would hardly have been safe, therefore, without a careful analysis of the life history record (which record was not kept locally until

METER JOB SLIP **№ 13099**

ADDRESS INDEX

NAME
OWNER TENANT

MAKE SIZE NUMBER

DATE REMOVED READING

TESTS REASON OUT

TESTED BY

FULL FLOW	MED. FLOW	SLOW FLOW	LOSS OF HEAD P. F.

GENERAL CONDITIONS

REPAIR PARTS REQUISITIONED	¥	●	TOTAL
TOTAL COST FOR PARTS			
HRS. MINS. LABOR ●			
TOTAL COST OF REPAIR			

FROST!

FINAL TESTS FINAL READING

FULL FLOW	MED. FLOW	SLOW FLOW	LOSS OF HEAD P. F.

REPAIRED BY

TESTED BY

Meter Job Slip (Actual Size 5½ in. by 8½ in.).

1931) of many meters, to have attempted to have set up our inspection schedule on the basis of registration. The problem at hand was to recondition as early as possible all meters which were known to be inoperative or which were suspected of under registering. Upon the completion of the meter repair quarters this work was undertaken and a schedule developed, the close adherence to which will result in the periodic inspection of every meter in use in the city once every five years.

Collecting—Testing—Replacement

In order to expedite the work of removing and resetting meters, a light truck was equipped with a special body designed to conveniently hold a supply of meters up to the 1½-inch size, as well as the usual fittings and tools required. Before removing a meter from a property the workmen are required to record on a tag (illustrated), which is subsequently attached to the

METER TAG

Name

Street

Meter

KIND SIZE NUMBER

Reading

Date 19 By

Reason Out

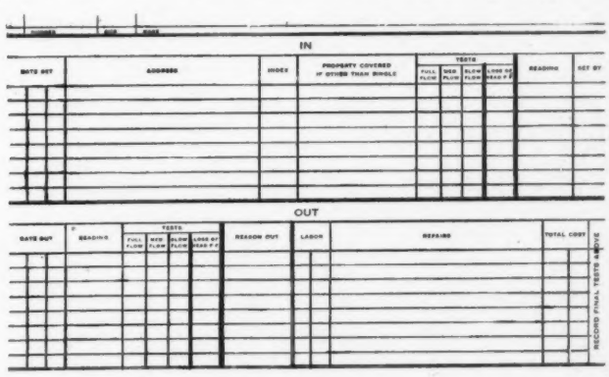
Meter Tag (Actual Size 2½ in. by 4¾ in.).

meter, the address from which the meter is taken, the number and reading of the meter, the date and the reason for the removal. The city, by owning all the meters in use, is enabled to replace, with a single call, the meter to be inspected by a repaired meter.

All meters upon being returned to the repair shop are placed in a large wash tray 3x9.5 feet, where the exteriors are washed and allowed to drip dry. Meters are then removed to the test bench where they are tested on three different streams. The usual practice is to require the meter to be tested while supplying water at the maximum rate for which the meter was designed, again at half that rate and finally at the smallest rate at which the meter will record the passage of water. The department is insistent that these initial tests be made wherever possible as it very frequently happens that subsequent to the replacement of the meter the consumer finds his bill materially higher and enters a complaint. Reference to the test data not infrequently furnishes a satisfactory explanation.

After being thus tested the meters are removed to the repair benches where they are opened, inspected and all parts are calipered. All brass parts are acid dipped and thoroughly cleaned. Worn parts are remachined or, wherever necessary, replaced. The meters are, after being repaired, returned again to the test bench for a final series of tests—similar to the initial tests described above.

The repair men are required to fill out a "Meter Repair Slip" for each meter before beginning any work



Form Used for Recording Meter History (Actual Size 8 in. by 5 in.).

thereon. The initial test data is indicated thereon and the slip is time punched at the beginning of the repair work and after completion of the final test. The repair men in addition are required to make notations on the Meter Repair Slip of the condition of the meter when disassembled, and to list thereon all material required in the reconditioning thereof. This slip, thus serving as a stock requisition, is presented to the stock clerk who checks thereon all material furnished from the stock room and returns the slip with the material to the repair man.

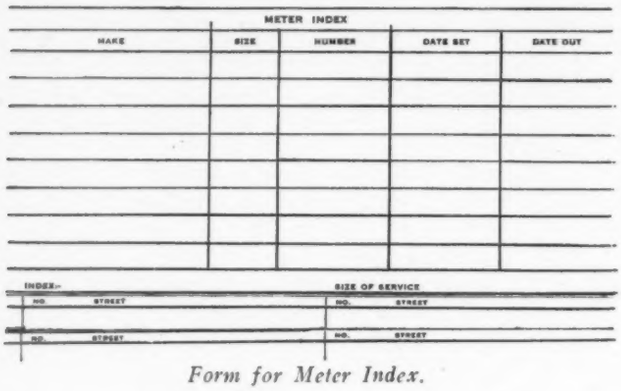
Meter History Record Valuable

After the completion of all work on a meter including the final test, the Meter Repair Slip is again turned in to the Stock Clerk. All essential data, including records of the initial and final tests, the cost of repairs, address from which the meter was removed and where set again, together with dates of removal and setting, are then entered on a Meter History Card which is filed by make and number for future reference.

Inasmuch as the Water Department indexes its services only by street and number it was found necessary to carry also a cross-index made up of cards filed in

visible arrangement showing the meter assigned to any particular property. This card is so designed that by the use of tabs it is readily determined in what year the meter assigned to any address was last inspected. This greatly facilitates the listing of meters to be removed for future inspection.

As an example of the condition of the meters when removed for inspection the author has averaged the initial tests of 500 of the 2,600 five-eighth (⅝) inch

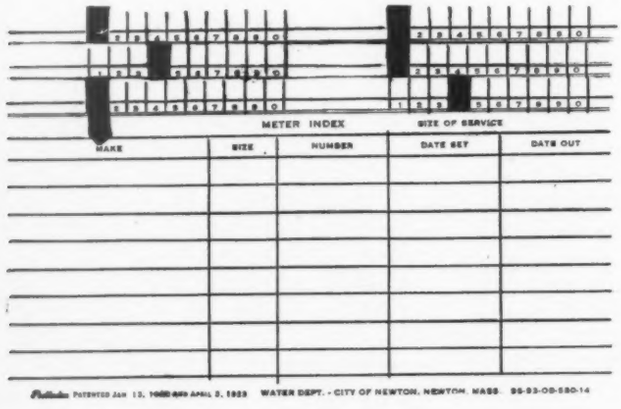


Form for Meter Index.

meters examined in 1933. The results are tabulated herewith:

	% Registration		Smallest Flow Registered		
Number	Full Flow	Medium Flow	1/32	1/16	⅛ or larger
500	86.3	87.2	290	136	74
	% of total number....		58.0%	27.2%	14.8%

It is interesting to note that of the total number of meters covered in the above tabulation there were 14.8 per cent which failed to register any stream of water smaller than ⅛ of an inch and 27.2 per cent which would not record the passage of less than 0.8 of a gallon per minute passed through the 1/16th inch orifice on our test bench. It would be difficult to determine how much water would in ordinary use be drawn at a rate which would not be registered by the combined 42.0 per cent; but, when one considers the tapering off of the flow, as a ball cock closes, the small streams used for refrigerating and humidifying purposes, it is apparent that such



Reverse Side of Form for Meter Index, Illustrating Use of Tabs to Indicate Year of Last Inspection.

meters must pass an appreciable quantity of water which is unrecorded.

Economic Results

Since getting the meter repair program under way some 12,300 meters have been handled in the repair department. Of this number approximately 2,000 have been "repeaters" resulting from vacancies, golf clubs and garden use. The actual benefit from the work done to date, therefore, can be only that resulting from the inspection and repair of but 66 per cent of the total number of meters. An analysis of the revenue figures for the last few years indicates that, as a result of the adoption of this systematic inspection program, a net gain of 12 per cent has already accrued to date. It would therefore appear that the Water Department, after completing the inspection and repair of the remaining third of the meters, might expect as a result of this work an annual revenue increase of approximately 18 per cent, an amount equal to four times the cost of the inspection and repair work and approximately six times the total cost of the additional investment required over the former cost of meter maintenance.

The regular monthly removal orders resulting from the office analysis of "stuck" meters now amount to less than .035 per cent in sections where the inspection has been completed, which may be compared to 1.6 per cent before the inspection and testing program got under way.

An analysis of the cost of repairing 2,600 (⅝-in.) meters reveals the fact that the average cost per meter (without any charge for shop overhead, records, etc.) is $1.07 divided as follows: (a) Parts—54.8 cents: (b) Labor—52.4 cents.

▼

Carbonizing Filters at Norfolk, Va.

A novel and interesting use of activated carbon is under development at the Norfolk, Va., filtration plants by R. W. Fitzgerald, Superintendent of Filtration, and F. E. Stuart of Industrial Chemical Sales Company.

The scheme involves the use of powdered carbon which is forced into the sand bed following the regular filter wash. For a unit of 1 m.g.d. capacity 4 lbs. of the "Aqua Nuchar" is used. The emulsion containing this weight of carbon is discharged to the suction side of the wash-water pump, during a 4 to 5 minutes period, *after* the regular wash is completed. Such an amount of carbon produces a turbidity of 30 p.p.m. in the wash water at the reduced rate of wash employed during the carbon application. The carbon has a chance to just begin breaking through the surface of the sand at the end of the 4 to 5 minute duration of application. At this time the carbon is shut off and the untreated wash water flushes the gravel bed free of carbon during an added 2 minutes of the slow wash.

The idea seems to be valuable in procuring a filter "sweetening" effect by distributing carbon particles onto the sand surfaces, something which normally does not take place during carbon application to the water entering the glters unless the sand be very coarse. In addition, there seems to be other benefits resulting.

In an article by R. W. Fitzgerald, scheduled to appear in a future issue of this magazine, the procedure and results will be discussed in detail. In the meantime, the idea has sufficient promise to justify these preliminary comments for the benefit of those interested in filter bed improvement.

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North Carolina's Second Water Plant Operators' School and Conference Scheduled

The First School and Conference for Water Plant Operators, held under the auspices of the N. C. State Department of Health in 1933, was sufficiently valuable to justify its continuation each year. The 1934 School and Conference will be held on June 25th, 26th, and 27th in Chapel Hill, N. C., at the University of North Carolina.

THE UTILIZATION OF SEWAGE

By N. T. VEATCH, JR.*

Consulting Engineer, Kansas City, Mo.

N. T. Veatch, Jr.

THE utilization of sewage has stood as a continual challenge to sanitary engineers ever since the collection and disposal of sewage has been recognized as a community obligation. The collection of "night soil" and its conversion into fertilizer antedates the water carriage sewer system, and, one is naturally impressed by the fact that many of the very early treatment processes seem to have been motivated to a considerable extent by the hope of deriving profit from the undertakings.

Recent attempts to utilize sewage, with but few exceptions, have had the reduction of the total cost of sewage disposal, rather than actual profit, as a main objective. The value of the products of sewage treatment varies so greatly with local conditions that general statements are likely to be misleading, but it may be said that in those cases where revenue exceeds or covers a considerable portion of cost, some unusual condition exists. One may cite such instances as the demand for irrigation water at Pomona, California[1]; for industrial water at Herington, Kansas,[2] or the extremely high cost of water which makes its reuse feasable at the Grand Canyon,[6] and irrigation needs at Tucson, Ariz.

Up to the present time no disposal process, which is generally applicable and which promises an actual profit, has been developed where there has not been some especial local demand for the products of sewage disposal; therefore, the utilization of sewage is limited to locations where there is such a demand, or where it can be developed.

It is told of P. T. Barnum, of circus fame, that, during winter seasons, he quartered his animals on his estate and frequently used his elephants for plowing. A visitor asked him one day if he found farming by "elephant-power" economical. His answer was, "Yes, provided you own an elephant." Probably this story, whether true or fabricated, will serve to illustrate the matter of the utilization of sewage, for it certainly is economical provided there is local demand for the product.

It is highly probable that the field of usefulness of sewage has not been fully explored and that further research along this line will disclose new uses for sewage products. The subject is at least worthy of consideration by designing and operating engineers on account of the possibility of reducing operating costs.

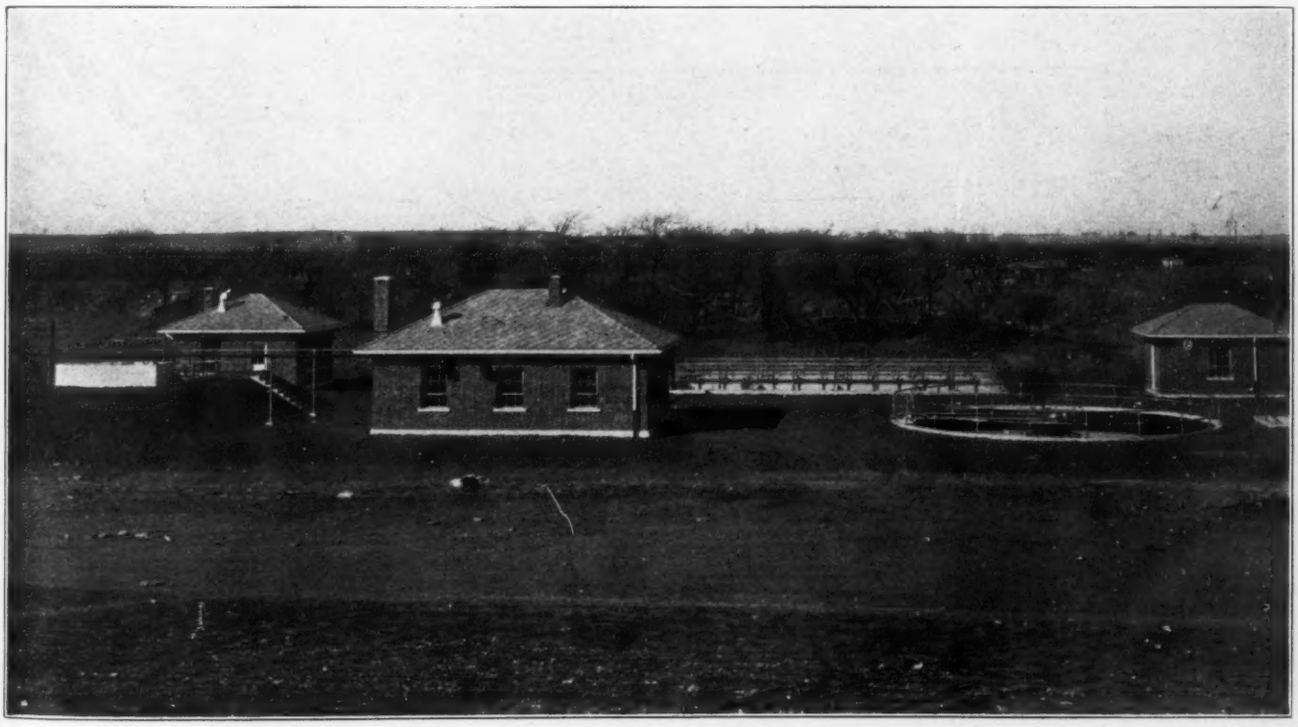
The products of sewage which have so far been utilized are as follows:

1. The effluent water.
2. The solids or sludge.
3. The gas from digesting sludge.
4. Grease.

The recovery of marketable ammonia has been demonstrated as possible in at least one process,[4] but this is still in the experimental stage.

It has been stated by Clark[5] that a million gallons of average sewage contains about $60.00 worth of fer-

*Member of the firm of Black & Veatch, Consulting Engineers.



New Sewage Treatment Plant at Herington, Kan. (Built with Funds from the R.F.C.). This Activated Sludge Plant, Put in Service November, 1933, Is to a Large Measure Self-Supporting. The Rock Island Railroad Purchases the Whole of the Effluent for Use in Locomotives and Shop Boilers at 5 Cents per 1,000 Gallons.

tilizing material (two-thirds of which is represented by ammonia in solution) and about $7.00 worth of grease; but he goes on to say, "It is easy to talk of this great waste and the desirability of preventing it, but it is a long journey to the year when a considerable percentage of it will be sold for profit."

Water Values

This evaluation does not consider the water which forms by far the greater part of sewage and it is probable that the discovery of uses for this water offers the most fruitful field for sewage utilization. The recovery of sewage for domestic uses other than as a drinking water has proved profitable at Grand Canyon, Arizona,[6] where the cost of the required treatment is less than that of an equal amount of new water. At Herington, Kansas,[2] the effluent of a new activated sludge plant, illustrated here, is being sold to a railroad company for use as boiler water. In this case the quantity of plant effluent is insufficient to meet the needs of the railroad and the difference which amounts to about 20 per cent, is made up with raw water from an impounding reservoir owned by the city. A charge of five cents per 1,000 gallons is made for the mixture of plant effluent and raw water (80:20), and the revenue is sufficient to cover all disposal costs plus the cost of pumping into an elevated tank which serves the railroad. This plant was built with funds furnished by the Reconstruction Finance Corporation and was put into service in November, 1933.

Treated sewage is sold for irrigation by a number of cities in the arid part of the country and the situation at Pomona, California,[1] is typical. Here the sale of plant effluent, on a long term contract, with an irrigation company, produces revenue to the extent of about half of the operating cost of an activated sludge plant.

A number of cities still dispose of sewage, in various stages of treatment, on land, and in some cases, as at Tucson, Arizona[7]; at Fresno, Calif., and in western Texas, the farms are operated by the cities. The revenue from farm products at Tucson for the fiscal year 1928-29 exceeded the operating cost (exclusive of fixed charges) of the entire sewer system, and in spite of the subsequent decline in the value of produce the farm operation now serves to reduce the cost of sewage treatment to a material extent.

The large scale experiments carried out at Los Angeles[8] on the reclamation of sewage, show that it is perfectly possible to purify it to the extent that it may be used with safety for any purpose, even as a potable supply if the psychological effect of its source could be eliminated. In other words, sewage water can be utilized whenever it is the most economical or otherwise acceptable source of water.

Fertilizer Values

The use of sludge as fertilizer is about as old as the treatment of sewage, but it is only recently that the fixation of nitrogen, as in activated sludge, has permitted the making of anything but a low grade fertilizer. The plants at Milwaukee, Pasadena, Houston, Indianapolis, and elsewhere have proved that it is possible to make a good fertilizing material by dewatering activated sludge, and that the financial success of the process depends on the price for which the product may be sold. At Milwaukee, for instance, the revenue from the sale of "Milorganite" amounted in 1929 to 68 per cent of the operating cost (exclusive of fixed charges) and the material was sold for approximately $20.00 per ton.[9] Beginning with the year 1930 the revenue has not been sufficient to pay for the processing of the sludge, and in 1932 the loss amounted to $6.90 per ton produced.[10]

The sale of dried digested sludge offers a more modest but decidedly brighter picture. It does not have the fertilizing value of activated sludge but its cost of production is far less. Tatlock[3] reports a profit of $967.00 from the sale of 475 tons of digested sludge* dried to a moisture content of from 10 to 20 per cent and states that, "As a result of the writer's experience, he is inclined to believe that sludge can be successfully marketed but it cannot be done without working on the job." Ryan at Rochester[11] reports that $1,724.00 was received from the sale of 6,898 cubic yards of sludge in 1930. At Pomona, California,[1] a profit of $414.00 was realized from sludge sales in 1929. These figures are small in relation to the operating costs of the proposed works, but are of interest since they offer a suggestion as to the disposal of sludge which is in itself a plant expense. Keefer[12] reports that all of the sludge produced at the Baltimore plant is being taken by local users and that a considerable expense for disposal is eliminated.

Gas Values

The gas produced by the digestion of sludge is worth something if properly utilized. Walraven[13] reports a yearly saving of approximately $4,000.00 from the use of this gas for the generation of power and at many plants it is being used for heating sludge during the process of digestion and is thereby reducing the cost of sewage disposal.

The recovery of grease while ordinarily not worth while, may in some instances be profitable. The amount of grease obtainable from the average run of municipal sewage is small and the quality of the product is such that its recovery is seldom worth while.

It would seem that the best chance for profit from sewage lies in its water value and that in many instances the use of suitably treated sewage (effluent) is warranted from an economic standpoint.

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*During the first 10 months of 1933 Tatlock reports sales at Dayton, O., totaling 1,369 tons of dried ground Imhoff sludge at $6 to $10 per ton, yielding a gross return of $9,500 and net profit of at least 45 per cent of the gross. See WATER WORKS AND SEWERAGE, Dec., 1933, p. 439. At Grand Rapids, Mich., 445 tons of dried ground digested sludge was marketed during 1932 at $9 to $10 per ton; net profit about $5,750. See WATER WORKS AND SEWERAGE, July, 1933, p. 244.—*Editor.*

BIBLIOGRAPHY

1. Digestion of Activated Sludge. F. H. Froehde, Journal California Sewage Works Association, 2:82-87, 1929.
2. Sewage-Plant Effluent for Boiler Water. Anon, Engineering News-Record, III:521-23, Nov. 2, 1933.
3. The Economic Preparation and Sale of Digested Sludge as Commercial Fertilizer. M. W. Tatlock, Sewage Works Journal, 4:519, May, 1932. (See also WATER WORKS AND SEWERAGE, Dec., 1933, p. 439.)
4. A New Chemical Sewage Purification Process. E. A. Cappelen Smith, WATER WORKS AND SEWERAGE, 79:420, Dec., 1932.
5. Past and Present Developments in Sewage Disposal. H. W. Clark, Sewage Works Journal, 2:261, Oct., 1930.
6. Sewage Treatment Plant at Grand Canyon National Park. H. B. Hammon, Municipal News and Waterworks, 75:303-8, Dec., 1928.
7. Some Operating Experiences in the Western Part of the Country. F. M. Veatch, Journal New Jersey Sewage Works Association, 1930.
8. Reclamation of Treated Sewage. R. F. Goudey, WATER WORKS AND SEWERAGE, 78:3, Jan., 1931.
9. Sewage Disposal Plant Operation at Milwaukee, Wisconsin. WATER WORKS AND SEWERAGE, Aug., 1930.
10. Five Years' Operation of the Milwaukee Activated Sludge Plant, Public Works, Nov., 1933.
11. Sludge Disposal at Rochester. W. A. Ryan, Sewage Works Journal, 3:479, July, 1931.
12. Large Scale Sludge Digestion Experiments at Baltimore. C. E. Keefer, WATER WORKS AND SEWERAGE, 80:151-6, March, 1933.
13. Power Production from Sludge at Springfield. W. B. Walraven, WATER WORKS AND SEWERAGE, 80:151, May, 1933.
14. The Utilization of By-products of Sewage Disposal. J. R. Rumsey, WATER WORKS AND SEWERAGE, July, 1933.

FEATURES OF THE NEW WATER PURIFICATION WORKS AT BURNT MILLS, MARYLAND

By ROBERT B. MORSE

Chief Engineer,
Washington Suburban Sanitary District, Hyattsville, Md.

Robert B. Morse

TO replace the existing temporary water purification works at Burnt Mills, and to meet more adequately the demands of the Washington Suburban Sanitary District, the Commissioners of that district now have under construction new works which contain a number of novel features.

Briefly, the works, which will have a nominal rating of 10 m.g.d., will consist essentially of a main pipe line delivering water from the existing dam to aerators of the Aer-O-Mix type, whence it will flow through a preliminary sedimentation basin giving a period of about three hours, and thence to a low-lift pumping station having a total installed pumping capacity of 20 million gallons per 24 hours against a head of 12 feet. In this pumping station coagulating chemicals and activated carbon will be applied in the suction wells. These, as well as liquid chlorine, may be applied also to the raw water, when necessary, before its passage through the Aer-O-Mix machines. From the low-lift pumping station the treated water will pass to the coagulating basin in which the nominal period will be about 55 minutes. No mixing basin has been provided. The course of the water thereafter will be as usual—through rapid sand filters, filtered-water reservoir, and thence to a high-lift pumping station. The total installed pumping capacity of this station will be approximately 24 million gallons per day against a head averaging about 275 feet. A pump of nearly two million gallons capacity, actuated by a hydraulic turbine through speed-increasing gears, is expected not so much to reduce the consumption of electrical energy as to aid gasoline engines in minimizing electrical maximum demand charges and service in emergencies.

The plans comprehend the construction of two five-million-gallon-a-day assemblies each consisting of a coagulating basin, four filters, pipe vault, filter-control house, and filtered water reservoir.

At the present time, one of these assemblies has been completed and will be operated temporarily through a gravity connection. In addition, the preliminary sedimentation basin, the foundations of the low-lift and hydro stations, and practically all of the connecting piping, sewers, and drains have been finished.

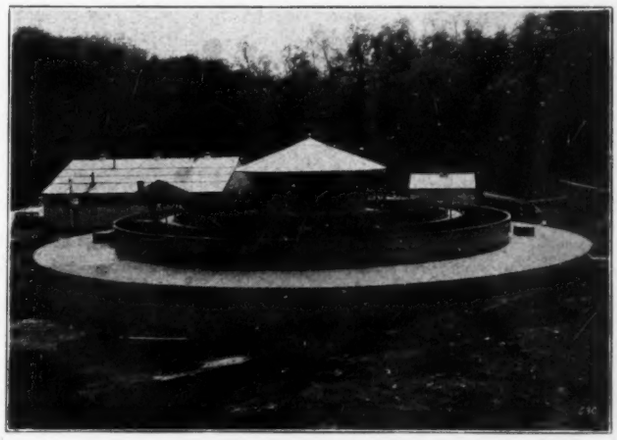
Novel Design Outgrowth of Construction Economy Studies

A desire to secure the utmost economy in construction without, at the same time, jeopardizing successful operation actuated the writer to depart from conventions in designing the Burnt Mills works. The most interesting features of this project consists, naturally, of those which are either novel or at least unusual.

The principal items meriting attention are the shape and arrangement of coagulating basin, filters, pipe vault and filtered-water reservoir; the filter bottom; the material of which the structures are made; electric heating for all buildings; and the uncovered condition of the filters.

Restrictions of space and configuration of the site called for the most compact arrangement possible. The writer had in mind the apparently unchallenged belief among engineers that the most compact and economical arrangement of filter-tank assemblies required rectangular units. Nevertheless, in checking up, he proved that cylindrical units permitted of at least equal compactness. This shape next appeared to have advantages for other constituents of a filter plant if certain difficulties could be eliminated. Then developed the conception of an arrangement under which the cylinders would be placed one within another, providing thus, through ring-shaped compartments, for the amount of space required by the several elements of the plant with the maximum degree of compactness.

In the Burnt Mills works, one 5,000,000 gallon-a-day assembly, consisting of pipe vault, filters, coagulating basin, and filtered-water reservoir, fills a circle having a diameter of 100 feet. A central cylinder having a diameter of 24 ft. 6 in. contains the operating piping and



Filtration Plant at Burnt Mills, Md.: Five M.G.D. Filter Assembly Containing Pipe Well—Control House, Filters, Coag. Basin and Filtered Water Reservoir.—Diameter 100 ft. A duplicate of the unit pictured is to be constructed on ground occupied by existing temporary plant in rear on left. For location and arrangements of all units, see General Plan of Plant.

valves. Outside of this ring four filters, arranged in accurate form, are bounded on the outside by a cylinder 54 ft. 3 in. in diameter. Between this ring and one having a diameter of 72 ft. lies the coagulating basin, outside of which, but within a 100-foot cylinder, the filtered-water reservoir is located. Topographical conditions prevented nesting of the preliminary sedimentation reservoir with the other basins, and consequently this was constructed at another point as a concrete rectangle 200 by 110 ft. in plan. A preferred location would have

been between the coagulating basin and filtered-water reservoir.

Appropriate piping connects the basins underneath their bottoms. All filters connect directly with a vertical stack in the center of the pipe vault, which in turn is connected with the filtered-water reservoir. Lime, liquid chlorine, and ammonia will be added to the filtered water. The control house, a building only 20 feet in diameter placed above the pipe vault, contains the compact Wil-

Interior of Filter Control House; Burnt Mills (Md.) Filtration Plant: Filter effluent stack and sight-well in center. Two of the four valve-control operating stands and rate of flow gages are shown on right and left.

liamson valve-control operating stands and rate of flow gauges.

All of the cylindrical tanks, arranged concentrically, stand upon a concrete slab. The shells surrounding the filters and coagulating basin are 14 ft. 6 in. in height and the outside ring of the filtered-water reservoir is 10 feet high. This basin holds 275,000 gallons of water and is covered.

Departure from Conventional Filter Bottoms

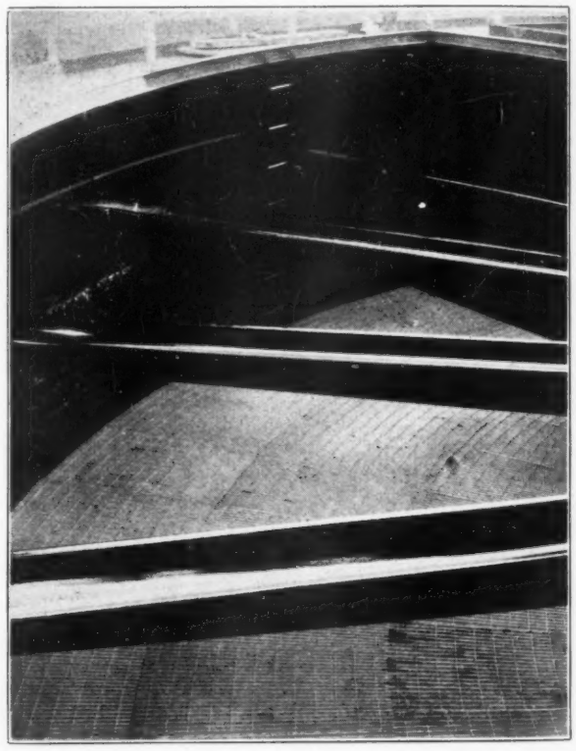
Filtered water is collected from, and wash water delivered to, the lower part of the filter tanks through

View of the First Unit Under Construction: Outside ring serves for filtered water storage; next is the coagulating basin; next, the four filters; next, the pipe-well (gallery); exact center, sight-well receiving filter effluent.

separate piping systems, each having three major openings so as to produce favorable hydraulic conditions. The gravel bed lies on a flooring of "Tri-Lok" grating. This grating is composed of galvanized copper-bearing steel. The inner ends of the bars are slightly pinched so that the sections fit radially. A structural steel frame provides support for the grating.

The pipe vault, control house, filter tanks, coagulating basin, and filtered-water reservoir are constructed entirely of structural steel plates and shapes welded in place. Notable economy in both cost and space was thereby secured. All surfaces in the filter tanks not readily accessible after placement of the gravel and sand, and the outside of the filtered-water reservoir below the finished ground level, were coated with bitumastic enamel. Cork-board lagging and ceiling protect the control house from extreme cold and heat.

All the buildings are to be heated by electricity. Estimates showed that this might be done at a total capital and operating expense as low as if oil heating were used. Electric current will cost but one-half cent per kwh. and no increase in maximum demand charge will occur since the maximum pumping demand is in the summer. The saving in installation cost is considerable by reasons of the elimination of furnace rooms, chimneys, piping, and radiators.

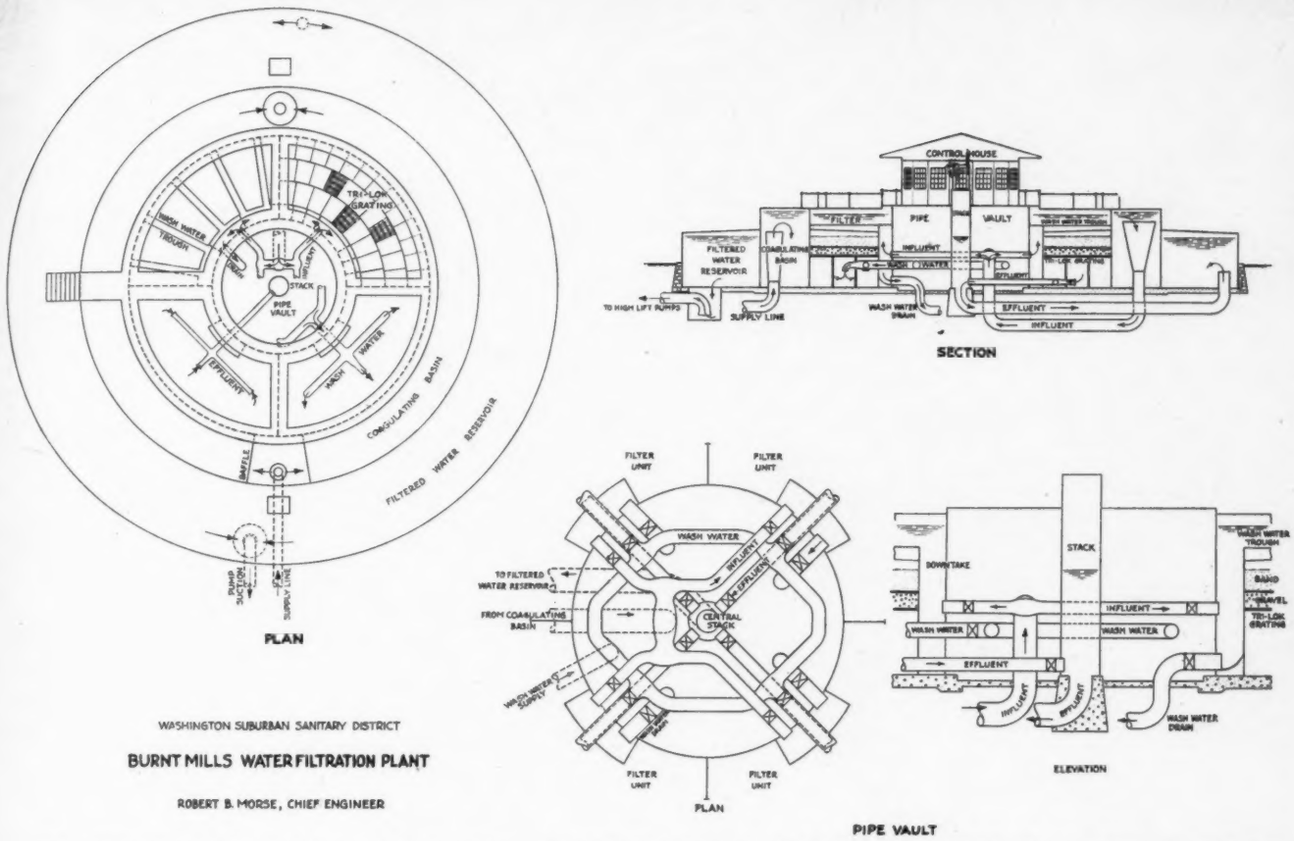


Interior of Filter Unit Ready for Gravel and Sand: Involving "Tri-Lok" grating for bottom; radical trough arrangement; steel work protected with Bitumastic Enamel Coating.

Uncovered Filters Effect Large Saving

The uncovered condition of the filters constituted an important feature by means of which a large saving in construction cost was made. The general arrangement used in this plant would be just as practicable, however, if the control house had been extended over the filters. The writer does not know of any uncovered rapid sand filters for all the year use in moderately cold climates except those at Burnt Mills. For the past six winters two filter units of 600,000 gallons daily capacity each have been operated there continuously in the open with little added labor cost and with highly satisfactory results. While most of the winters were much above normal and one was the warmest on record in this vicinity, two periods of real test occurred. In the winter season of 1929-1930 there were 153 days between October 5 and June 1 on which the recording thermometer at Burnt Mills fell to freezing point or below.

The following tabulation compares the temperature



The Filter-Coag. Basin—Clear Well Assembly of the New Filtration of the Washington Suburban Sanitary District—at Burnt Mills, Md.

readings for that winter with those of the one just past.

No. of days with minimum temperature

	1929-'30	1933-'34
of 20° or lower	54	55
15° or lower	33	36
10° or lower	19	25
5° or lower	10	16
0° or lower	7	9
-5° or lower	3	4
-10° or lower	2	1
Minimum temperature	-11°	-14°
Average minimum for coldest consecutive period of 2 days	-9°	-9°
3 days	-3.3°	-5.7°
5 days	4.8°	-2.4°
10 days	5.8°	1.1°
15 days	6.0°	5.1°
30 days	12.8°	6.8°
32 days	....	6.8°

Methods of operating the filters during cold weather have been the subject of experimentation. Sometimes they were operated under an ice coating reaching a thickness as great as eight inches, with no loss in efficiency. Ordinarily the ice was kept in a broken condition by the drop of water level during washing, and some of it passed off to the sewer. At other times the operators skimmed the ice from the surface as it formed, which required only infrequently an appreciable amount of effort. Constant movement of the water during filtration, and especially violent agitation at times of washing, usually prevented troublesome ice formation at temperatures higher than from 10° to 15° above zero. At lower temperatures frequent opening of wash-water valves for a brief period, without drawing down the water level, gave good results.

The only serious difficulty encountered in the operation of open filters proved to be progressive freezing of the sand inwardly from the outside steel plating. This will be prevented in the new filter units because they are surrounded by the water in the coagulating basin. Due to the position of the filters in a ring around the control house, observation of the condition of the water will be almost as easy as in the ordinary plant. Specially designed under-water lights will aid at night.

The writer has made a comparison of temperature readings at Burnt Mills with those at many other places and he feels certain that even in many considerably more northerly locations open rapid sand filters may be operated at a great saving. Where too much extra labor might be expected, electrically-operated heating devices may be installed, as is now the case where trouble from needle or anchor ice occurs.

At present it is impossible to state just what the cost of the completed project will be. The Commission's own construction forces are doing all the work except the steel erection. The Chicago Bridge and Iron Works furnished and erected the steel assembly consisting of pipe vault, filter tanks, coagulating basin, filtered-water reservoir, and control house for the 5,000,000-gallon unit, including all influent and effluent devices of steel, filter-bottom supports, all walk-ways and railings, and the Euboeolith flooring, cork-board lagging and ceiling, doors, windows, and screens to complete the control house, everything unpainted. The cost to the Commission of approximately $24,000, which amounts to $4,800 per million gallons of daily capacity. The cost of the Tri-Lok grating filter bottom amounted to about $400 per million gallon capacity.

Had the site been more favorable, allowing a single 10,000,000-gallon nesting of preliminary sedimentation and coagulating basins, filters, and filtered-water reservoir, also only one building for housing raw-water and service pumps, as well as chemical machinery and stor-

age, the cost of the completed works would have been greatly reduced. Work has progressed sufficiently, however, to make certain that the entire project, comprising a 10,000,000-gallon filtration plant, two pumping stations with installed pumping capacities of 24 m.g.w. and 20 m.g.d., a small hydro station, a 1200 kva. transformed station, roadways, walks and other improvements to the grounds, including flood walls and fills, will cost less than $350,000. Engineering and administrative expense is not included. Thus the peculiar disadvantages of the rough and rocky site have not entirely obscured the marked economy resulting from the shape and arrangement of the filter plant proper and the material of which it was made.

The writer wishes to acknowledge the ingenuity shown by Mr. Charles O. Wherley, an assistant engineer with the Commission, in developing many details for which no precedent appeared at hand.

Acknowledgment: This article has been prepared from notes used by the author in presenting an illustrated talk before the Maryland-Delaware Water and Sewage Works Association, at Washington, D. C., May 3, 1934.

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Board of Engineers Recommend Changes in Chicago's Sewage Disposal Program

As the result of the PWA allocation of a $42,000,000 loan and grant to the Chicago Sanitary District for extending its sewage disposal facilities, a Special Board of Engineers was appointed by the PWA to review and report on the existing program and plans of the district.

If the board's recommended procedure, involving fundamental changes in the existing program, are followed out it is estimated that on the average a 72 per cent degree of purification will be given the entire sewage of Chicago as against a 56 per cent treatment by the former plan. In effect, the board's recommendation provides for treatment of sewage which could not have been handled at all in the previous program, with the funds to be made available.

To reduce the size of treatment works, and thereby save in their construction and operating costs, an important recommendation is that a program of water metering be put in effect. The metering project will reduce sewage volumes and save an estimated loss of $12,000,000 per year by the city, now suffered through water waste by consumers.

Two other important recommendations of the board are the following:

(a) Provision of an additional 400 m.g.d. activated sludge plant to treat sewage from the Southwest Side area, including the Packing House district. Such a plant, not now in the program, is preferred to any immediate attempt to supplement the existing West Side $16,000,000 Imhoff Tank Plant.

(b) That the 500 m.g.d. Imhoff Plant, serving the West Side, be continued. Further, that endeavors be made to improve the performance of this plant to produce 70 per cent purification by adaptation of chemical precipitation methods, with or without final (rapid) filtration.

The latter recommendation calls for large scale demonstrations of chemical methods which the board comments on as having an attraction (if proven practicable) because of "greater compactness of plant and lower construction cost."

The board believes that such tests merit consideration —not as a primary treatment under Chicago conditions; but—as a supplementary method for use in conjunction with existing or proposed plants and should, therefore, be tested on a large scale to determine its adequacy and cost as compared with other processes—principally the activated sludge process.

The board also recommended that studies of mechanical dewatering and incineration of sludge be continued and prosecuted to a definite conclusion as rapidly as possible.

The following eminent engineers comprised the board which studied the situation for four months before the report was rendered: Prof. Daniel W. Mead; W. B. Storey; Brig. Genl. C. W. Kutz and Joshua D'Esposito (PWA Engr. for Ill.).

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Eighth Conference Pennsylvania Sewage Works Association

The 8th Annual Conference of the Pennsylvania Sewage Works Association will be held at State College, Penna., June 27-28-29th. The program prepared seems an extraordinary interesting one and those who have in previous years attended the Water and Sewage Conferences at State College can attest the ideal location of these meetings, the economy of the dormitory facilities provided and the golfing on College Course. The vacation and technical features combine ideally at State College. The meeting follows on the heels of that to be held by the Water Operators Association on June 26th and 27th.

PROGRAM

Wednesday, June 27th

Time (Eastern Standard)

1:00 p. m. Golf Tournament—Water Works vs. Sewage Works Operators.

8:00 p. m. "Some of the Newer Sewerage Developments Abroad." (Illustrated Lecture.) Dr. W. Rudolfs, New Brunswick, New Jersey.

Thursday, June 28th

Morning Session

9:30 Address of Welcome—Prof. F. G. Heckler, State College, Penna.

9:45 "This Trickling Filter Fly: Its Habits and Control"—Prof. Gordon M. Fair, Harvard University, Cambridge, Mass.
Discussion: Harry J. Krum, Allentown, Pa.

11:00 "Elutriation and Filtration of Sewage Sludges"—Albert L. Genter, Chemical Engineer, Baltimore, Md.
Discussion: C. E. Keefer, Baltimore, Md.

12:00 Luncheon.

Afternoon Session

1:15 "Comparison of Vacuum Filters and Open and Glass Covered Sludge Drying Beds"—Frank Woodbury Jones, Cleveland, Ohio.
Discussion: Wellington Donaldson, New York, N. Y.

2:15 Special Report of Operators' Licensing Committee.

3:00 Sewage Treatment Plant Operators' Symposium.
1. "Hershey Sewage Treatment Works and Its Operation"—H. N. Herr, Hershey, Penna.
Discussion: I. M. Glace, Harrisburg, Penna.
2. "The Operation of the Hanover Sewage Treatment Plant and Its Sewage Ejector Stations"—C. A. Eckbert, Hanover, Pa.
Discussion: R. C. Gorman, Jr., Harrisburg, Pa.

4:30 Recess.

7:00 Dinner and Round Table Discussion. H. E. Moses, Harrisburg, Pa., Master of Ceremonies.

Friday, June 29th

Morning Session

9:00 "Plant Operation"—W. L. Stevenson, Harrisburg, Pa.
Discussion: H. M. Beaumont, Philadelphia, Penna.

10:00 "Notes on Sedimentation"—Prof. L. V. Carpenter, Morgantown, W. Va.
Discussion: F. B. Foote, Pittsburgh, Pa.

11:00 "Sludge Digestion at Meadville"—C. H. Young and Roy L. Phillips, Meadville, Pa.
Discussion: J. R. Hoffert, Harrisburg, Pa.

Noon Adjournment.

"WATER WORKS KINKS"

By E. E. JACOBSON and CLARK CRAMER

Respectively, Chief Engineer and Station Engineer, Lexington Water Co., Lexington, Ky.

MANY of the things described in this paper are not new but are from a number of widely scattered plants and in some cases are truly "kinks" in that they constitute an individual's solution of a problem that confronted him. This paper is presented with the purpose of paying tribute to the originators of these "kinks" and with the hope some of the suggestions may be of help to those who have similar unsolved problems.

We wish to acknowledge the help of Mr. Martin E. Flentje, Superintendent of Purification, Community Water Service Company, for his many suggestions, pictures and prints furnished with this paper.

The methods to be described will be divided into three classifications, viz.:

(1) Purification; (2) Pumping; (3) Distribution Systems.

Application of Chemicals

It is often necessary to improvise the means of adding alum to a supply at some location where it is not convenient or practical to use a dry feed chemical machine. Barrels are quite commonly used, but without a constant head orifice box the feed cannot be set so to be relied upon, because of the variation due to a changing head. By one of the engineers of the Pennsylvania Health Department, we were introduced to a rather ingenious emergency float valve arrangement that made such a solution feeder easy to make. An ordinary barrel is set up, and to the outlet pipe is connected a heavy walled hose of any kind—a piece of common garden hose, for instance. Placing a float ball or stoppered bottle on the outlet end and cutting a slit crossways, in the upper side, of the hose, will provide a good enough means for controlling the flow into an orifice box for emergency use. When the level in the orifice box is lowered, the float will drop and gradually open the slit cut in the hose and allow more solution to flow through. When the float does the opposite this slit will close and practically stop the flow—thus the constant level is fairly well maintained in the orifice box.

Another emergency device can be assembled without the orifice feed and yet maintain a constant flow by fastening one end of a thin walled rubber tube to a float

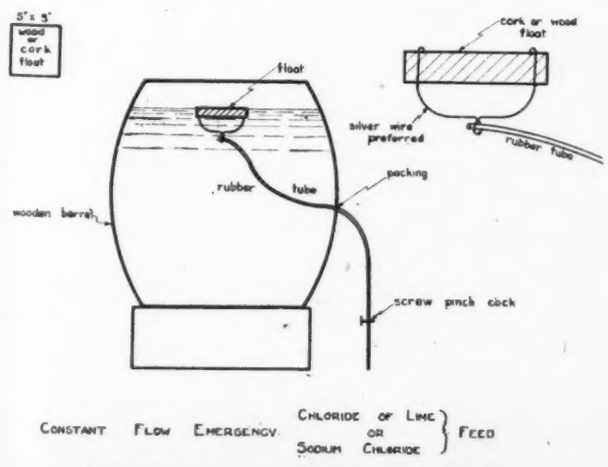


Fig. 1.—Emergency Solution Feed Device

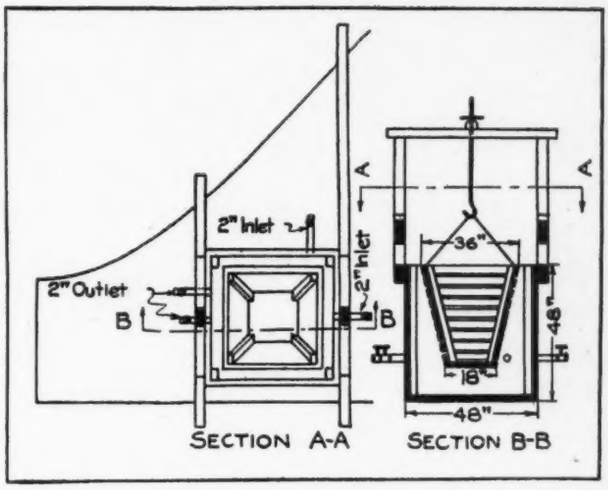


Fig. 2.—Lump Alum Feeder—Basket Submersion Type New Rochelle (N. Y.) Water Co.

of cork, wood or stoppered bottle in a barrel. The hose passes through the side of the barrel and the flow from the barrel is controlled by a screw pinch cock or other suitable arrangement on the rubber tube. The open end of the tube in the barrel is kept at a constant distance below the liquid by means of the float. See Fig. 1.

An Alum Feeder

It is also sometimes desirable to add alum to flowing water. An installation that seems applicable to other places and conditions is that installed at the New Rochelle Water Company reservoirs. This consists of a crib like container for lump alum, which can be raised or lowered in a water channel, allowing considerable variation in the amount of alum that will come into contact with water passing through and thereby controlling the amount going into solution. (See Fig. 2.) Greater flexibility was also obtained by having several inlet and outlet pipes, so as to vary the amount of water flowing through the device. Originally this particular device was used in a flume through which water was passed at a 3 m.g.d. rate. This water was colored and at times turbid, and by using such treatment between two storage reservoirs good turbidity and color removal were obtained without filtration.

Pumping Constant Amounts of Chemical Solution Into a Main Under Pressure

A device is employed by the New Rochelle Water Company to apply soda ash to water under pressure. In this, use is made of duplicate storage tanks, a constant head orifice box, a delivery tank, and a plunger pump which draws from the delivery tank and delivers to the main. The pump operates against the constant head in the transmission main and, by means of a float controlled valve in the delivery tank, pumps either into the main or through a by-pass back into the tank. Thus the chemical solution added to the water in the main is just the amount fed into the delivery tank by the orifice box and the delivery tank serves as the pump

intake reservoir. Designed by Mr. J. G. DeVeau of the New Rochelle Water Company, it has been successfully used for a number of years. (See Fig. 3.)

An Alum Feeder Regulated by Amount of Saturated Alum Solution Formed

At Dennison, Ohio, alum is continuously fed through a home-made apparatus that C. O. Romig has good reason to be proud of. The outfit consists of a long rectangular box, 12 by 12 by 31 inches, the sides of which come together at the bottom. Under this is placed an old rubber battery box to which is attached a 1¼ inch soft rubber hose leading to the raw water line.

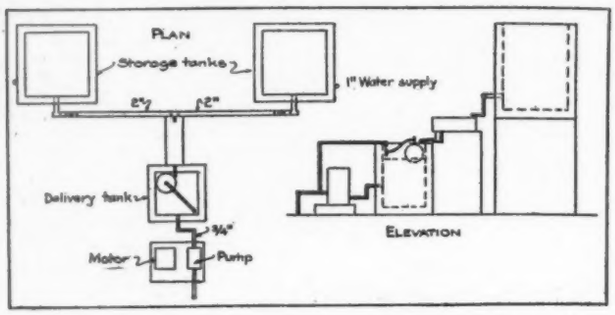


Fig. 3.—Equipment Used to Introduce Alkali, Dechlorinating or Other Solutions Into Mains, Under Pressure New Rochelle (N. Y.) Water Co.

Above this box is a lead basin with a small valve on the outlet on the lower side, and so arranged that water is kept overflowing through a spout at the side and down into the battery box, thus giving constant flow at a constant head. Lump alum is placed in the box, and the dosage is then set by the amount of water allowed to trickle over this alum. A concentrated alum solution is formed and then diluted somewhat in the rubber basin below. This device has a range from about 100 lbs. or less, to over 1,000 lbs. per 12 hours.

Mixing Several Chemicals Under Pressure

During the experimental work at Bristol, Rhode Island, it was necessary to mix ferrous sulphate solution with chlorine under sufficient pressure to apply the chlorinated-copperas solution at some distance from the mixing point. This was accomplished in a closed keg as set up by Messrs. Enslow, Hedgepeth and the local operator Mr. La Fleur. The copperas was fed into an ejector, this solution passing through the keg into which

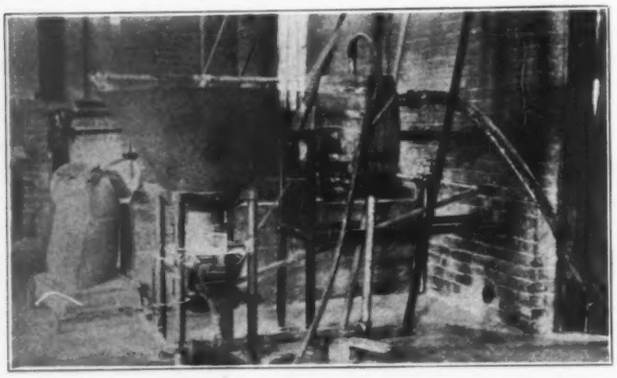


Fig. 4.—Method of Oxidizing Ferrous Sulphate with Chlorine (Under Pressure) at Bristol, R. I.—The Chlorinated-Copperas Solution Leaves Through the Large Hose

the chlorine solution hose was connected, so that solution of copperas, mixing and iron oxidation was insured. The accompanying illustration (Fig. 4) was only a temporary (experimental) set-up to determine the possibility of the scheme. It worked quite satisfactorily after the keg tightened up.

Clarification of Reservoir Waters With Alum

The clarification of waters in reservoirs where filtration is not available is usually an interesting problem. At Berwick, Pa., use is made of a device very similar to the one at Dennison, but a great deal larger. This particular one is largely automatic inasmuch as the water flowing through the alum is a proportionate amount which passes over a weir ahead of the alum hopper. Mixing is obtained in a flume and a large amount of water that would normally need to be by-passed to waste is now successfully treated and clarified.

Applying Chlorine Directly From Cylinders to Reservoirs

Clorination of distribution reservoirs or impounding reservoirs is often desirable. This can, of course, be done by the use of chloride of lime, or such compounds as HTH, Perchloron, etc., but these are not always available, whereas practically every plant has on hand liquid chlorine in cylinders. Chlorine gas, however, must be fed into water at considerable depths, and anyone who has tried to apply it from a boat or under shallow depths will know what a disappointment such a procedure is. To Messrs. Ed Trax and Gerrit Buchanan of McKeesport, Pa., goes the credit of having developed a means of using gaseous chlorine under such conditions. A chlorine delivery hose is connected to the chlorine cylinder placed forward and reclining in the boat. The hose is run to discharge chlorine just below the propeller blades of an outboard motor. (See Fig. 5.) Such an arrangement with the outboard motor operating at a fair speed will prevent chlorine from coming to the surface, even when sufficient chlorine is applied to freeze up the outlet end of the hose.*

Fig. 5.—Outboard Motor Arrangement For Applying Chlorine to Reservoirs. Hose Line Discharges Gas Just Below Propeller.

Methods of Applying Carbon

A number of easily applied methods of adding activated carbon have been given in literature distributed by Industrial Chemical Sales Co. covering the application of Nuchar. It seems best to keep carbon in suspension while applying it, and at Springfield, Kentucky, a small electric fan converted to a mixing propeller was used for this purpose. The motor shaft was replaced by a longer one, and the fan blades were sheared off except for about one inch. This agitated the suspension satisfactorily and prevented clogging of the small rubber hose used for siphoning out the Nuchar suspension. At Apollo, Pa., an old Ford transmission was utilized in a rather large tank. At Campbellsville, Ky., a fan similar to the one described at Springfield was used, except that the motor was water driven.

*A word of precaution is in order. Chlorine ice blockage of the hose outlet may cause sufficient pressure on the hose to result in rupture. Heavy pressure hose and some form of pressure indicator should be employed. Ye Ed. speaks from experience—almost disaster.—Ed. Note.

Laboratory Kinks

Bacterial Baskets

When running bacterial samples it is often quite a task to keep the fermentation tubes upright in the commonly used wire baskets, and to keep those of one sample together. The very simple arrangement made of galvanized iron by Gerrit S. Buchanan has proven of a great deal of help in our various laboratories. It provides a support for the basket at such an angle that the tubes will stay in place without trouble.

Numbering Fermentation Tubes

In laboratories running a large number of water samples, particularly where Standard Methods are followed, and at least 5-10 cc. fermentation tubes planted numbering all of these tubes with the lab. number of the sample takes up a great deal of time, and later on it is rather difficult to get these grease pencil marks off. Placing a card that fits snugly into the basket and is somwhat higher than the tubes allows placing the sample number on this card and removes the necessity for numbering each tube. One of our laboratories goes even further than this, and numbers a hundred of such cards, and uses them over and over again.

Use of Aluminum Foil to Cover Bacterial Sample Bottles

The use of cloth over the tops of water sample bottles is well known, and a number of laboratories have long used a lead or tin foil that does quite well in protecting the sterile top in handling. It is probably not so well known that aluminum foil can be obtained and used for this purpose, and that it is very satisfactory. A foil having the following dimensions has been found very satisfactory, and each square can be used for several shipments, if handled with reasonable care.

Foil for Ordinary 2 oz. glass stoppered water sample bottles: Aluminum Co. of America Alcoa Aluminum Foil can be had in sheets of .0015 in. (thickness) and 5 in. square (Aluminum Co. of America). One pound contains approximately 300 sheets, and the price is very nominal being approximately 80c per pound.

Measuring Turbidity

Standard Methods does not provide a means for accurately measuring turbidities below 5 p.p.m. In filtered water the Baylis turbidimeter is easily operated to measure turbidities as low as 0.10 p.p.m. The outfit is somewhat cumbersome and a later turbidimeter, known as the "Fleming Turbidimeter," is a simple device. With it turbidities from 0 to 2.0 p.p.m. can be measured. A modification has been constructed by H. E. Jordan at Indianapolis.

Another turbidity measure shown by Chas. E. Spaulding of Springfield, Illinois, consists simply of two 50 or 100 ml. Nessler tubes and a plate of blue and a plate of white glass. By holding the tubes so that they are directly over the blue glass superimposed on the white one so that the blue field covers half of the bottom of the Nessler jars, it is very easy to compare and determine turbidities. Using a 1,000 p.p.m. standard turbidity suspension enough is added to one of the tubes containing distilled water until the blue fields have exactly the same appearance. This method can be used for turbidities as low as 0.50 p.p.m. and without dilution up to 10 p.p.m. If a 50 ml. sample is used 1 ml. of the 1,000 turbidity solution will equal 2 p.p.m. and in a 100 ml. sample 1 p.p.m.

Indirect Lighting

Ease and accuracy in measuring turbidity and the various color reactions observed in water tests depends a great deal on the quality of light available. Among other very ingenious devices, the laboratory of the Indianapolis Water Company has installed means for making these readings under indirect constant quality artificial light to insure the same light conditions on every test. Such an arrangement has been found of decided advantage. A special colored light is used in making chloride titrations, whereas day-light bulbs are used for the other color tests.

Standard Lime Solution

A saturated lime solution may be used as a standard for measuring the lime required to correct the pH of a certain water or for any such practical purpose, such as softening, without weighing and going to the trouble of making up an absolutely standard solution. One cc. will contain 2.2 milligrams of lime or 1cc. equals practically 10 p.p.m. if applied to 200 cc. of water sample. The addition of a coagulant will assist in clarification of the saturated lime water which can be thus filtered through absorbent cotton.

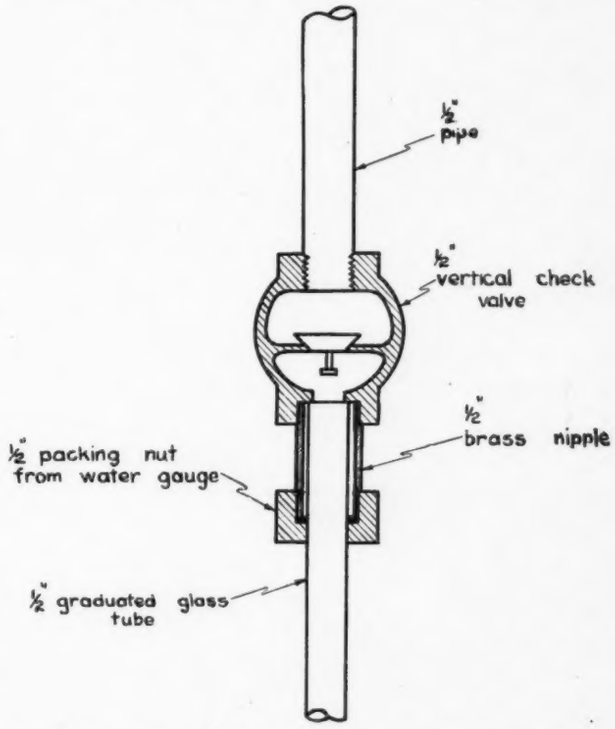


Fig. 6.—Sludge Measuring and Sampling Device

Keeping Both Eyes Open When Using a Microscope

Those using a microscope infrequently find it hard to keep both eyes open and use only one in looking through the eyepiece at the image, as is recommended in all books on microscopy. This can be done by fitting a strip of black paper that is possibly 2 in. wide and 4 in. long over the eyepiece and allowing it to extend out before the face in the direction of the eye that is not to be used. Both eyes, with this arrangement, can easily be kept open, and while probably not highly technical serves the purpose very well.

Running Iron Tests

In laboratories not having permanent iron (color) standards, it appears to be common practice to set up a series of standards of different increasing values for each test or series of tests for iron. It is possible to make such determinations without using more than one standard tube, by simply adding the acid, permanganate

Fig. 7.—Operating Floor of Filter Plant, Westmoreland Water Company at Greensburg, Pa. Sight Well in Extreme Right Foreground; Laboratory on Extreme Left. Inset is a View Looking Down Through the Plate Glass Cover of the Sight Tube, Lighted from Below

and thiocyanate to this one standard and then adding increasing quantities of the standard iron solution to it. By comparing the solutions under test in the order of increasing iron content considerable time and labor can be saved. This method is not absolutely correct, checks made on it according to Standard Methods indicating a possible error of approximately 10 per cent.

Counting Bacterial Plates

Indirect lighting of the plate counter used for determining total counts on bacterial samples helps a great deal. This is accomplished practically by placing the counting frame in a space surrounded on three sides with glass covered supports. Inside of these are placed electric bulbs and it is claimed that more accurate plate counts can be made than in any other way.

Plant Equipment

Measuring Sludge in Basins

Measuring the depth of sludge in a settling basin and determining its character is often desirable in a water plant. For this purpose, at the Lexington Water Company plant the following device has been developed. A Crane air-release valve is connected to a standard coupling into which is packed an ordinary boiler gauge glass tube of any desired length. Lowering this slowly into the basin displaces the air in the tube through the release valve and collects a representative sample of the sludge and water in the basin. In drawing it out the release valve prevents air from entering and confines the sludge and water giving a visual picture of the basin contents at various depths. The tube can then be emptied by simply up-ending it. (See Fig. 6.)

A Sight Well for Filtered Water

Sight-wells such as that installed at the Westmoreland Water Company's filter plant at Greensburg, Pa., and at other modern plants—Winnetka, Ill., Easton, Pa., et al.—are not only a good means of showing consumers how clear the finished water is, but also serve as very efficient turbidimeters. (See Fig. 7.) A very slight turbidity in the clear well water is noticeable in this particular installation. While no actual tests have been made, it is believed that turbidities of 0.5 or less are readily noticeable.

Control of Filtration Rate in Old Tub Filters

Many old filter plants still have wooden tub filters, or other types, on which no controllers were placed when installed—or if installed, have become obsolete and unworkable. This had happened at the Lexington, Kentucky, plant and controlling the rate of filtration in these filters presented quite a problem. Finally a practical substitute scheme was hit upon in which the constant level automatically maintained in the settled water basins ahead of the filters was utilized. By actual measurement the influent valve to each filter was set so that the water coming in could not exceed the accepted rapid sand filtration rate—which is a 3 inch per minute rise in the filter box in this instance. The effluent valve is then so operated that the water in the filter tub is maintained at a constant level. The filter is washed when the effluent valve has reached the wide open point and the level of water in the filter box begins to rise above the fixed level.

Water Heater for Chlorinators

In sections of the country where the water temperature drops below 40 deg. F. chlorine ice usually forms on the inside of the bell-jar on the Wallace & Tiernan chlorinator. At the Lexington plant this trouble has been overcome by heating the supply of water to the chlorinator. The heater is made by welding a 10 inch section of 2 inch pipe over a 1 inch pipe, the steam being

admitted into the chamber formed between the two pipes. A thermometer in the outlet of the 1 inch pipe, which indicates the temperature of the water to the chlorinator is very important so as to control the steam and not let the supply water become so warm as to effect the hard rubber. The heater is by-passed during the warm months, and has proved most effective during the winter weather. (See Fig. 8.)

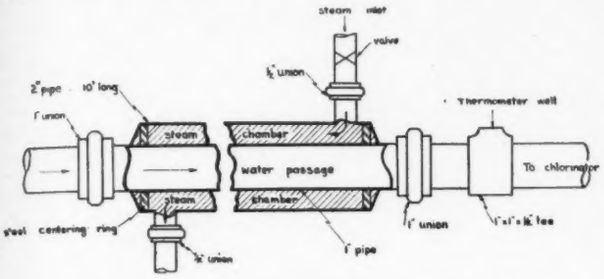


Fig 8.—Chlorinator Feed-Water Heating Device

Water Ejectors

Feeding solutions such as chemicals with water ejectors has caused trouble in many plants. This is not an economical method of feeding chemicals but under certain conditions is the most practical. In one plant the method of operating the ejectors was greatly improved by increasing the size of the 1½ inch discharge line to 3 inch and replacing in the discharge line all 90 degree ells with 45 degree ells or long radius bends. The discharge line should be so erected that a cleaning rod or long handle wire brush can be pushed through the pipe occasionally for cleaning without moving the equipment such as alum tanks or taking out the discharge pipe line.

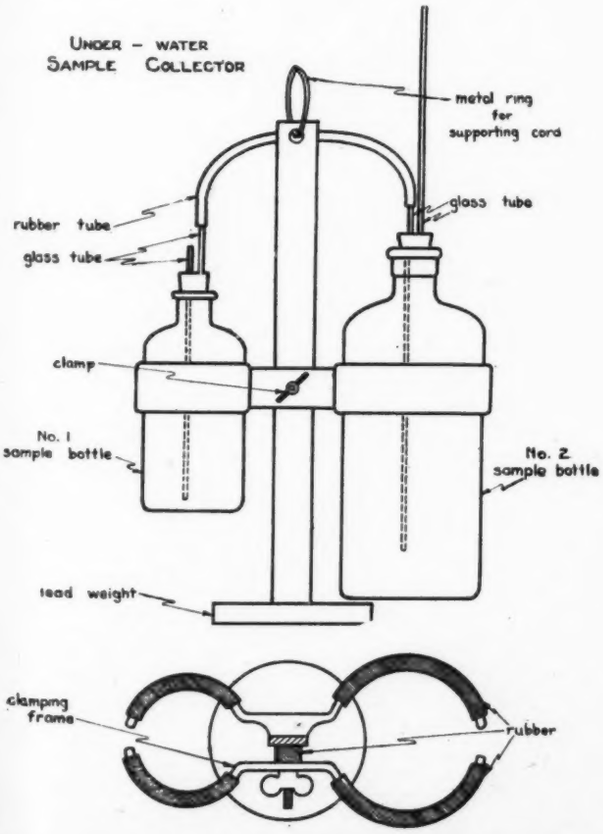


Fig. 9.—Device for Collecting Water Samples from Beneath the Surface of Reservoirs, or Streams

Under-Water Sample Collector

In taking samples for dissolved oxygen test or for collecting samples for algae and microscopic organism count from various depths in the lake or river, water must pass through the small bottle in filling the large bottle. The desired depth can be obtained by the device and in filling the large bottle, the sample obtained in other depths is washed from the small bottle into the large sample bottle. When air bubbles stop coming to the surface, the bottles are full of water. (See Fig. 9.)

Distribution Kinks

Thawing Fire Hydrants

In extreme cold weather in Lexington, Kentucky, occasionally trouble is had with frozen fire hydrants. The Lexington Water Company supplies each piece of the city's fire fighting equipment with a rubber stoppered quart bottle of concentrated sulphuric acid in a wood box. When the firemen find a frozen hydrant they pour the acid in the hydrant barrel through the hose nipple. The acid creates heat which dissolves the ice and the water pressure washes both melted ice and acid from the hydrant barrel. A frozen hydrant can be placed in operation in less than 2 minutes by the use of acid. It has not been found that the acid after such short contact has any ill effect on the metal of the hydrant.

Pipe Wrench With Bent Handles

Turning pipe and fittings in the bottom of meter boxes or small vaults is inconvenient to say the least. Pipe wrenches with handles bent at 90 degrees from the side of the wrench and extension tee-handles welded to the end of the handle simplifies the pipe work in these close quarters.

Freezing Lead and Soft Copper Service Pipe

On house service pipe lines it is often necessary to make a repair between the main and the curb cut-off. In most cases it is not practical to get to the cut-off at the main or cut off the water in that section of town. Repairs may be made by freezing the lead service with a mixture of ice and salt, providing there is no flow through the service line.*

Although not recommended for permanent repairs, wooden pegs made of soft poplar wood make very good emergency temporary repairs.

Cleaning Metal Meter Parts

When repairing meters the most difficult parts to clean are the intermediate gears and the register gears and dials. The method used by the Lexington Water Co. is to dip the gears in nitric acid, then dip in warm water, dip next in a half and half solution of nitric acid and sulphuric acid, washing again in warm water. The gears will be clean and bright after this acid treatment.

In conclusion the authors of this paper wish to make clear that all of the "kinks" set forth in this paper are not original at Lexington, Kentucky. However, most of the "kinks" outlined have assisted in solving certain problems in Lexington. No doubt every plant operator and water works superintendent has short cuts and ingenious devices for accomplishing certain things which would be a material benefit to other water works men. The authors hope that by the presentation of this paper it will lead to the publication of many more water works "kinks" and better ones than herein recorded.

Acknowledgment.—The above article is based on a paper presented before the Kentucky-Tennessee Section of the A. W. W. A. at Knoxville, Tenn.

*Solid carbon dioxide (dry-ice) may be utilized for more rapid freezing of services by placing it on and around the side of the pipe if care is taken in handling, to preclude frosting of fingers. —Editor.

THE PRESENT DROUGHT AND THE BRUCKNER CYCLE

By HALBERT P. GILLETTE

ABOUT 40 years ago Bruckner published an analysis of European data that indicated the existence of a weather cycle of about 35 years. He thought that it varied considerably in length; but several meteorologists have pointed out that if there are even a few more long cycles they might so interfere with the Bruckner cycle as to give it an appearance of variable length.

There is a rain cycle of 22.24 years, as shown by an analysis of sequoia tree-ring thickness for the last 3,100 years. One of its rain peaks was in 1883, near the time of a Bruckner cycle peak, which at least partly accounts for the rainy years of the 80's. The last peak of the 22.24-year rain cycle was due in 1928, but a Bruckner rain valley (or minimum) is due in 1934. Hence, there was considerable opposition of effect of these two cycles in 1928. Several other important rain cycles unquestionably exist, and until their exact lengths and amplitudes are known, accurate weather forecasting will be impossible.

Dr. H. W. Clough, formerly of the Weather Bureau, has been a weather cycle researcher for more than 30 years. He has written several papers in which evidence as to the Bruckner cycle has been given. In the Astrophysical Journal, 1905, he gave a table of European grain prices from the year 1290 onward, by which he showed the existence of a 36-year cycle. In the March (1934) issue of the Bulletin of the American Meteorological Society, there is an abstract of a recent paper of his, in which he speaks of the Bruckner cycle as being one of the causes of recent droughts. He now gives 37 years as the length of that cycle, and says that one of its minima of rainfall and maxima of temperature was due in 1932.

My analyses of tree-ring data and of clay-varve data make it certain that the length of the Bruckner cycle is exactly 36 years. I find also that the well-known 2-year cycle inverts its phase every 36 years, and that the inversions occur at the rain minima of the 36-year cycle. Periodic phase inversion is found in several other cycles, and perhaps explains why so many researchers have despaired of finding cycles that can be used successfully in forecasting weather.

There is opposition of phase in winter and summer in the case of many, perhaps all, cycles. This tends to obliterate evidence of a cycle when annual data are used. Europe. This refers to winter weather.

Using the sequoia tree-ring measurements made by Prof. Douglass, I have been able to show that a peak of the 36-year rain cycle occurred in the winter of 1880-1881. Hence the present year is a year of minimum rainfall in the Bruckner cycle. This agrees fairly well with Bruckner's own cycle of dry, hot years in Europe.

Taking the middle year in each of the series of cold, wet years, as given by Bruckner, we have:

Cold	Wet
1738	1745
1773	1776
1813	1815
1843	1848
1878	1878

These years cover only 4 Bruckner cycles, which is an inadequate number for the determination either of the exact length of the cycle or the dates of its peaks. But by using sequoia tree-ring measurements, the effects of more than 80 Bruckner cycles are available. Similarly by using the De Geer and the Antevs' measurements of annual thickness of silt (clay varves) deposited in ancient glacial lakes, scores of Bruckner cycles may be tested analytically. Such analyses establish conclusively the existence of a cycle of exactly 36 years. They also show that other cycles often obliterate the effect of the Bruckner cycle, but that it persists in reasserting itself.

It is very surprising that our Weather Bureau has never published either the tree-ring measurements of Prof. Douglas or the clay-varve measurements of Prof. De Geer or of Dr. Antevs. Those measurements furnish the most reliable data by which to determine the existence of long cycles like the Bruckner cycle. Perhaps the explanation of this failure of our Weather Bureau to publish these data is to be found in the fact that for many years the head of the Weather Bureau had been among the greatest of skeptics as to the existence of weather cycles. It is to be hoped that his successor will be less skeptical.

Unless there are weather cycles accurate long-range weather forecasting must always remain impossible of attainment. This consideration alone justifies the abandonment of the spirit of chronic skepticism as to cycles that has pervaded our Weather Bureau ever since the death of Prof. Bigelow. Dr. Clough was a worthy successor to Prof. Bigelow, but several years ago he was asked to resign. The writer was told at the Bureau that Dr. Clough's services had to be dispensed with as a measure of economy!

Prof. Huntington has suggested that the cedars of Lebanon should throw a great deal of light upon weather cycles in the Mediterranean. They resemble the California sequoias in many ways, including their great age. Our Weather Bureau should employ Prof. Douglass to direct the measurement of the annual rings of a great many of those ancient cedars, as well as of other ancient trees all over the world. Tree-rings as weather recorders have never been the objects of systematic investigation by any weather bureau. Why not?

▼

The Maryland-Delaware Water and Sewage Works Association Holds 8th Conference

The 8th Conference of the Maryland-Delaware Water and Sewage Works Association, held in Washington, D. C., on May 3rd and 4th, was a very successful one. The program was one of the best and the registration 124.

New officers elected for the year 1934-1935 were:

President—Carl J. Lauter, Chief Chemist, Water Department, Washington, D. C.

Vice-President—L. D. Shank, City Manager, Dover, Del.

Vice-President—J. V. Cannon, Chemist Water Dept., Hagerstown, Md.

Sec'y.-Treas.—A. W. Blohm, State Dept. Health, Baltimore, Md.

The Conference in 1934 will be held at Annapolis, Md.

WATER WORKS and Sewerage Equipment *of "Yesterday and Today"*

Believing it entertaining and also instructive, we present a picturized story of some of the old and some of the new in Water Works and Sewerage Equipment in America.

In many instances it has been possible to show equipment of the same manufacturer as it appeared years ago, and as it now looks in 1934. The manufacturers' cooperation in making this feature possible is appreciated.—Editor.

The First Reservoir to Serve New York City
The Manhattan Co.'s Reservoir on Chambers St. Built in 1925.

Mr. Jones (*to indignant Wife of his bosom*). "You see, Mrs. J., 'taint wholesome, th' Crot'n, so Bill'n'I's b'n obliged (hic) t'drink (hic) brandanwat'r (hic) all day! Shocking, ain't it?"

Poor Beggar of a Bachelor. "Do you mean to say, Mrs. Soapsuds, that you consider this shirt clean?"

Washerwoman. "Faith, an' it's as clane as I can make it, in the prisent state of the Croton."

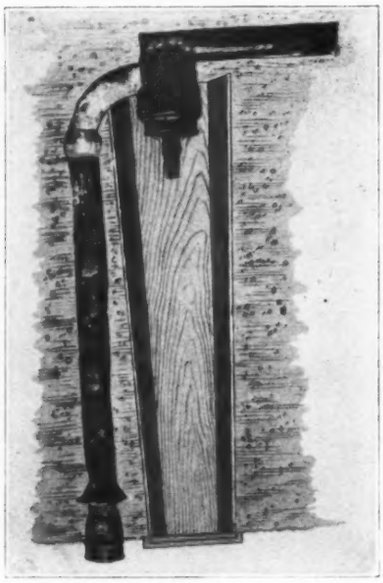
Conscientious Plumber. "'Tain't my fault, m'm, that the pipes won't work; its all owing to the Croton, which bu'sts 'em and rusts 'em."

Something Wrong With the Croton

In 1859, New York citizens raised some objection to the new Croton Surface Supply. Says the Conscientious Plumber: "The Croton rusts 'em and busts 'em." Seventy-five years later it still does. (Picture reproduced from Harper's Weekly of Aug. 27, 1859.)

A Century of Progress in Water Works Equipment at Richmond, Va.

An Early Patented Fire Hydrant at Richmond—the Eclipse

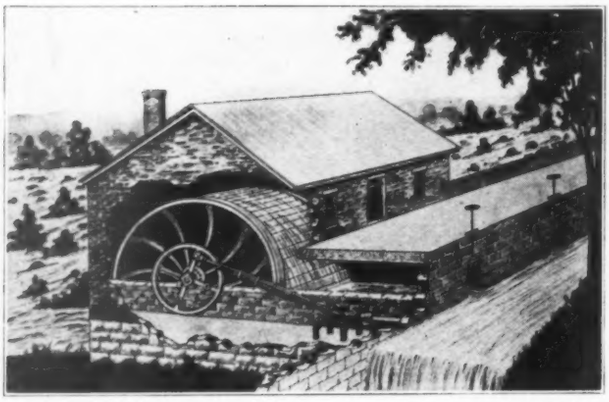


The "Fire Plug" of 1830

Installed in Richmond, Va., in 1831, this 3-inch "fire plug" represented the earliest of the "stand-pipe" style of hydrants. The vertical pipe was made of sheet copper with cast-bronze outlet and cap.

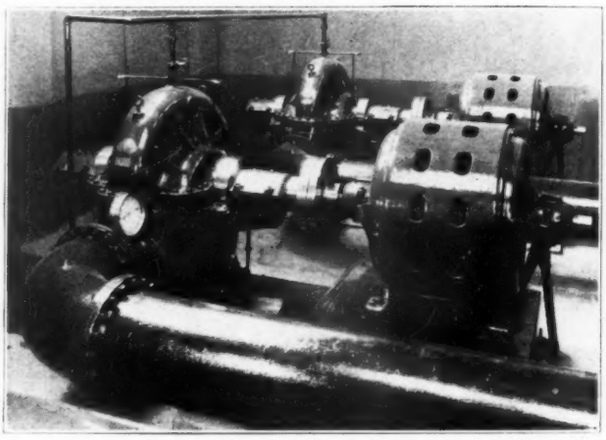
One of Richmond's Most Modern Hydrants

This Corey hydrant has one 8-inch and two 4-inch hose connections which may be operated independently.



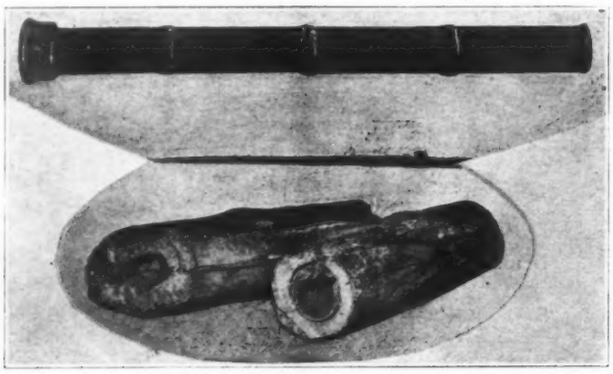
Richmond's First Water Works Pumping Station—1832

Section of the original pump house designed by the engineer, Albert Stein (1830), and put in service early in 1832. For many years all water pumping was done with hydraulic engines. The unique driving rod shown here is preserved as a relic in one of Richmond's parks. Unknown to many, Richmond had in 1835 what is presumed to be the earliest mechanical type water filters in America.



Richmond's Newest Booster Pumping Station

Contains three of these modern De Laval pumps of 20 m.g.d. cap. each.

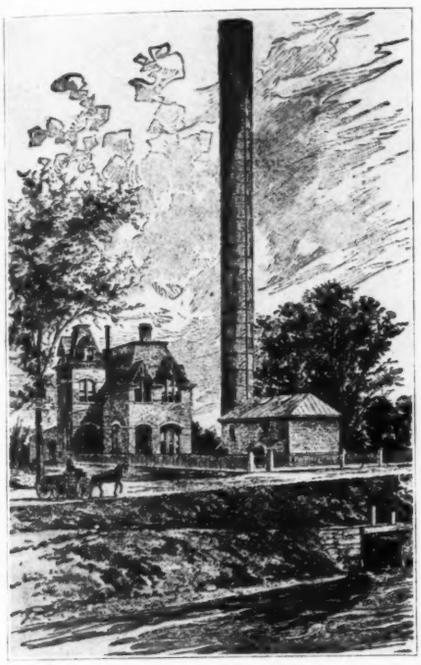


Richmond Second American City to Install Cast Iron Pipe—104 Years Ago

Philadelphia (Pa.) installed the first cast-iron pipe in America. At Richmond (Va.) the pipe, shown above the original wood pipe, was installed in 1830 or 1831. The Richmond pipe (diameters of 3 to 10 inches) had walls from ⅜ to 9/16 inches thick. The tapping bands shown were referred to as "swells" in the early reports of Richmond's Engineers.

Acknowledgment — Photographs and history on this page were supplied by M. C. Smith, Engineer of Water and Electricity, Richmond, Va. Reference—Original reports of Albert Stein, Engineer who installed Richmond's first Water Works System, 1830-1832.

Developments in Filtration Equipment

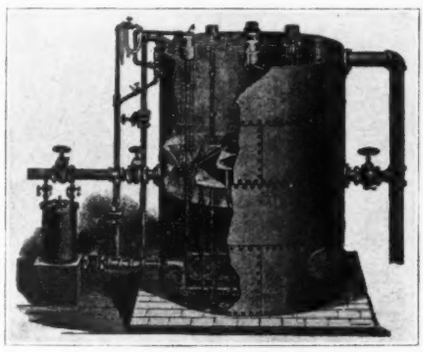


The First Municipal Plant to Adopt Mechanical Filtration in America Was Most Probably That at Somerville, N. J.—1885

Richmond, Va., probably had the first (1832) mechanical filters of a kind—had upward flow and washed by down flow. No coagulant used. The Somerville filters were the patented Hyatt filters installed by the Hyatt Pure Water Co. For the first time alum was used to coagulate the water prior to mechanical filtration at the Somerville plant.

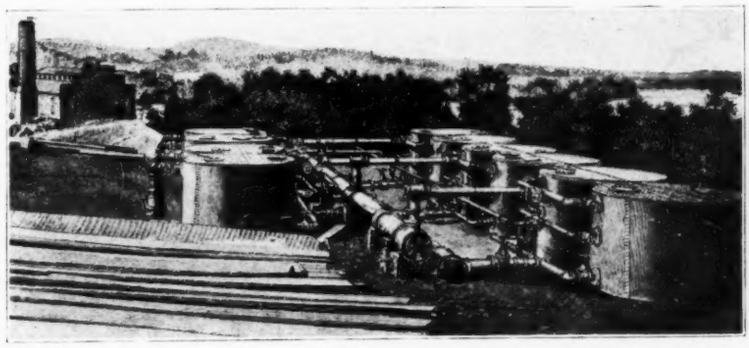
The Atlanta, Ga. (Hyatt) Filter Installation Was the Second Made—1887

For a time the largest municipal filtration plant in the world. Photo, courtesy W. M. Rapp, Supt. Water Works, Atlanta, Ga.



The Original "Hyatt Pure Water Filter" Installed at Atlanta, Ga., and Still Available for Use if Needed

The sand was washed by jetting it from the filter bed to the upper chambers. Clean sand was dropped down to the filter shell by opening the valves on the pockets. Capacity 500,000 gpd. each.

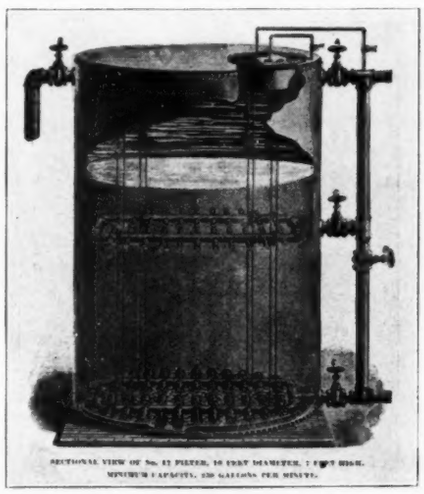


The Chattanooga, Tenn., Plant (American Water Works and Electric Co.) Was Equipped with National Filters in 1888—Capacity 3 M.G.D.

The filtration idea was taking rapidly in the South. Strangely, the Northern filters were "slow," while the Southern were "rapid."

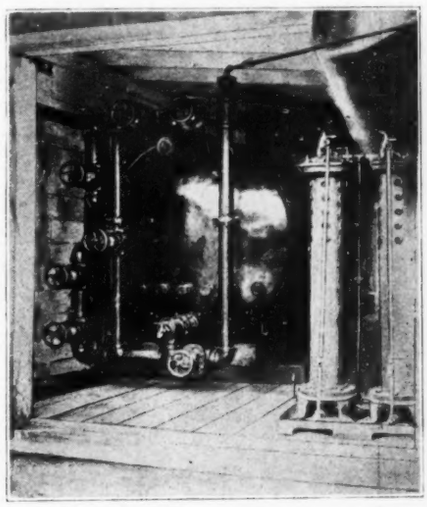
The National Water Purifying Co.'s Filter of 1888 Installed at Chattanooga

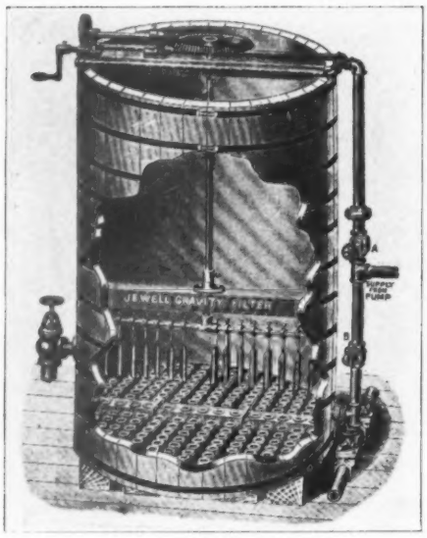
Interestingly, the National Filter featured the Surface Wash System—very much the same scheme as now employed by Baylis in the Chicago Experimental Plant. Slogan of the National company was "Great Economy by Surface Washing."



The First (Experimental) Installation of Filters of the Continental Filter Co. at Passaic, N. J.—1890. Large and Small Units (Second Picture at Right)

Here the air-wash system was developed by David Williamson, engineer of the Continental Co., who was succeeded by Jos. E. Williamson.



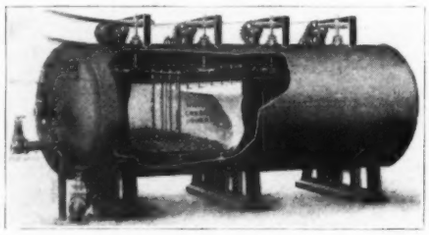


The O. H. Jewell Filter Co.'s "New Gravity Filter" of 1891

First used at Rock Island, Ill. Capacity of plant, 2 mgd. The first Jewell Pressure type filters were installed at Lake Forest, Ill., about the same time—earlier probably. Jewell featured the Gravity Open Top Filter. Claims—"Oxygen, being the most abundant purifier of nature, is an economical agent for rendering waters pure and wholesome. These filters, being open on top, allow such conditions to occur and afford a convenient means of inspecting operation of the filter in all detail." Specially prepared crushed quartz was a part of the filter specification. Claim—prevention of bed packing, easy washing.

The Now Famous Mechanical Filtration Experimental Plant at Louisville, Ky., Which Made History in 1895 *and* 1896

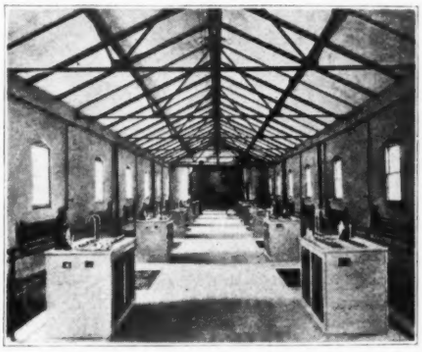
The man in the picture is Mr. Ira Jewell, of the Jewell Filter Co. Geo. W. Fuller was in charge of the demonstration and investigation—with Robert Spurr Weston, J. W. Ellms and the late Geo. A. Johnson as members of staff.



The Improved Jewell Pressure Filter of 1912. *"A Tank Within a Tank."*

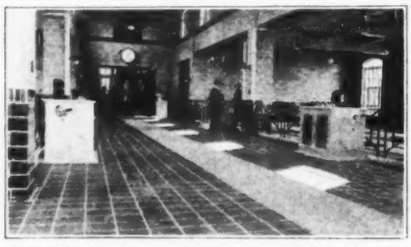
The catalog explained that the space between the two shells "forms a subsidizing tank wherein all water entering receives coagulation and sedimentation before passing on the filter bed."

Acknowledgment—To Jos. E. Williamson, formerly Engineer-Manager of the N. Y. Continental-Jewell Filter Co.; Frank Green of Little Falls; E. T. Killam of the firm of Alexander Potter, Engrs., we are indebted for illustrations of early filters.

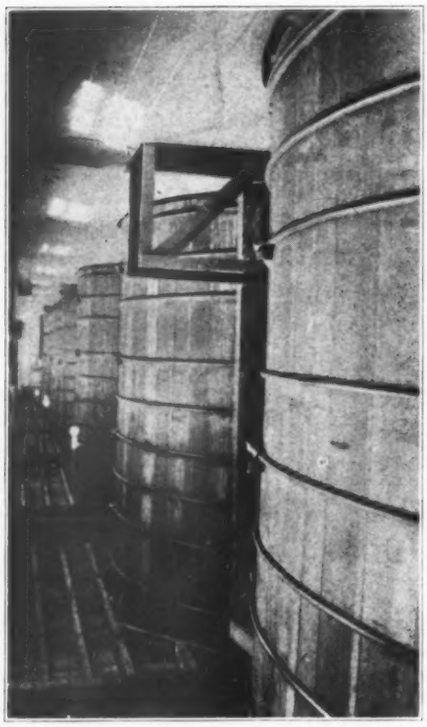


The First Filter Plant (Little Falls, N. J.) to Be Designed by Consulting Engineers (1901)

Concrete units and operating tables were an innovation 33 years ago in this filtration plant. Hering and Fuller, engineers. Equipment by N. Y. Continental Jewel Company.

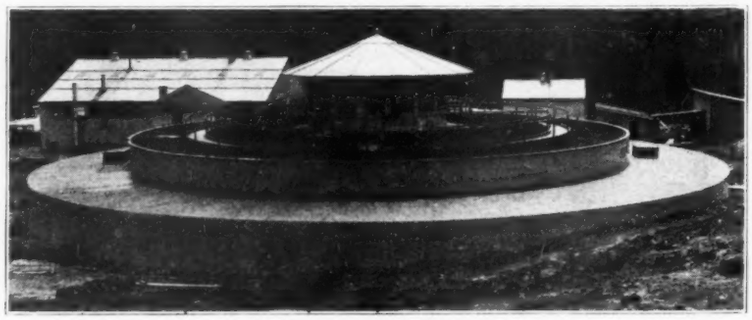


Operating Floor of the New Plant Placed in Service in 1932 *By the York Water Co. —Designed by Fuller & McClintock, Engineers*



New York Continental Two Story Wooden Filters—1898

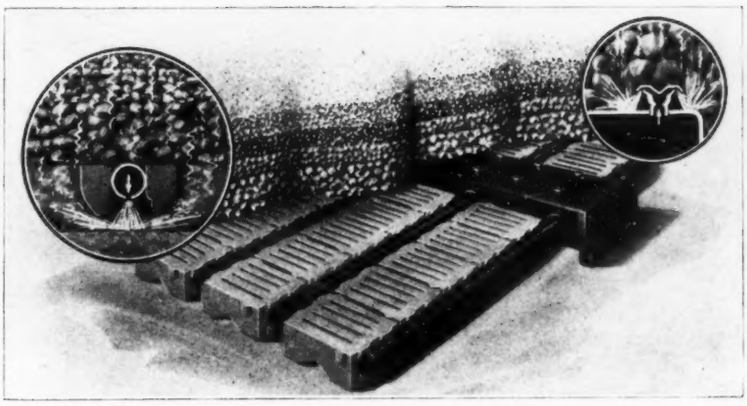
Modern equipment when installed 36 years ago for the York Water Company, York, Pa.



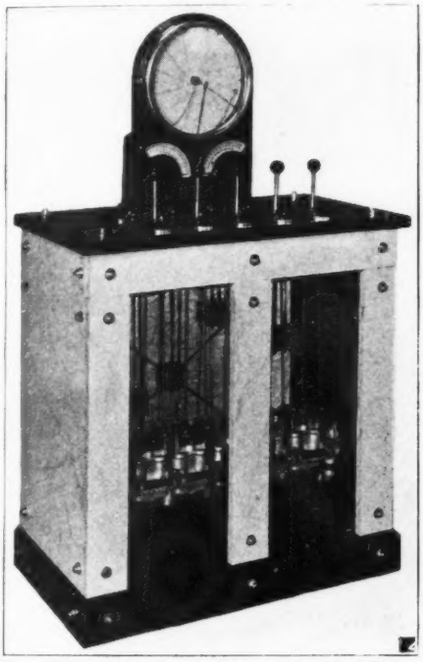
The Most Novel of Filtration Plants—The "Streamlined" Plant of 1934

In the Washington Suburban Sanitary District, at Burnt Mills, Md., the above first unit in a filtration scheme has been just completed. Circles within circles constitute what might be termed a "concentric" 5 mgd. plant—all complete in a diameter of 100 ft. The outside ring is the clear-well, then the coagulating basin next, then filters and the center well is the pipe gallery-well with operating "circle" above. Is economical, compact.

The Newest of Large Filtration Plants
North Operating Gallery—the new Springwell's Plant at Detroit, Mich.



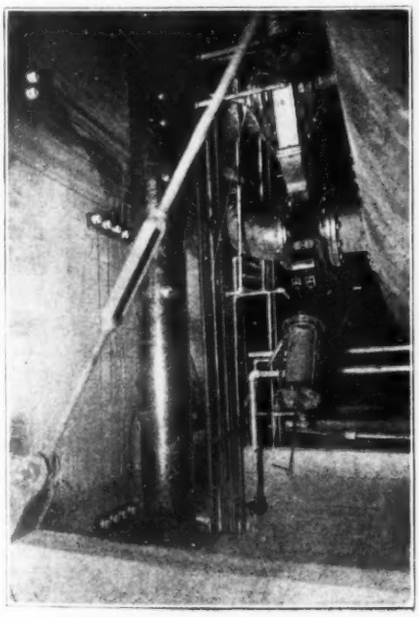
International Filter Co.'s Latest Development in Filter Underdrain Systems
The "sprinkling pot" strainers were superseded by the umbrella or mushroom type; then came the drilled laterals. Now the Wagner Underdrain System pictured above keeps all gravel from the drilled lateral pipes. Can be had completely built of non-corrodable Johns-Manville "Transite," with all metal excluded.

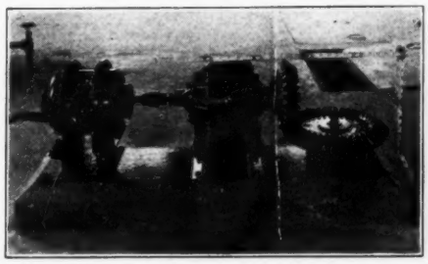


The 1934 Model of International Filter Co.'s Filter Control Table
Equipped with the modern compact gear-shift type of hydraulic 4-way switches; bears little resemblance to the earliest (Continental) "Operating Tables" of 1901 at Little Falls, N. J. Has eliminated complicated piping and 4-way plug type cocks employed in earlier models.

The "Selecto-Valve" Filter Control Stand Is as New as It Looks
A product of Jos. E. Williamson, the engineer who was responsible for the design of the first (Continental-Jewell) operating tables in 1900. Has been installed in America's most novel filtration plant just completed at Burnt Mills, Md.

1934 Model of Universal's (Heliocentric) Speed Reducer
Motor and reducer are integral; the drive, direct and concentric. Reductions of 5760 to 1 possible with designs now offered. The above is a shop picture of one of four units installed in the new Wilmette, Ill., filtration plant—(ratio 600 to 1) for mixing tanks.





The Earliest Installation of the Heliocentric Drive Speed Reducer Is at the Crookston, Minn., Filtration Plant
The Universal Gear Corp., of Indianapolis, Ind., introduced this type of equipment in the water works field only about 8 years ago.

Left: The Pipe Gallery of 1901—That of the Little Falls (N. J.) Plant

Right: The Pipe Gallery of 1934—That of the York (Pa.) Water Co.'s Plant

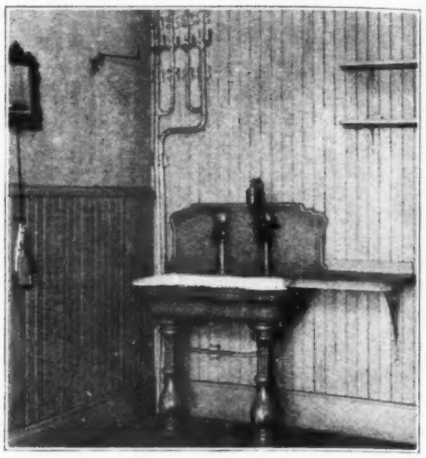
Aeration

An Early Low Efficiency Step Type Aerator

Superseded by cascade type, spray type, diffused air type, entrained air type, coke-tray type and the multi-cone type of aerator.

The Newest in Aerators

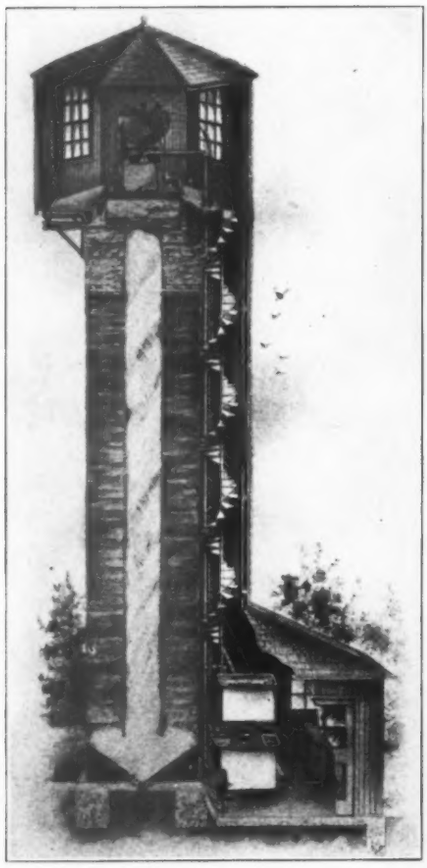
The compact, low-head, non-clogging Infilco Multi-Cone Aerator is constructed of aluminum to reduce weight and resist corrosion. Space required is only a fraction of that of the obsolete step type pictured on this page. Produces much higher efficiencies than other aerators on a 4-ft. head requirement.



Kitchen Sink of "The Gay Nineties"

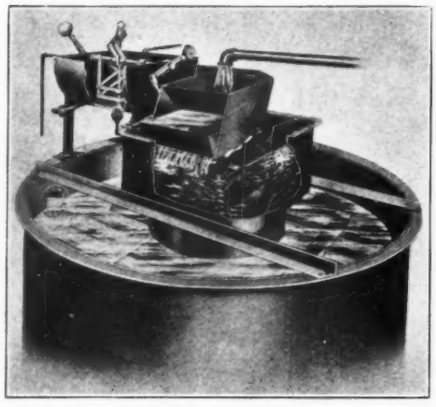
Plenty of "Gingerbread" and lead piping. Two kinds of water—hot and cold. Pardon the error—three kinds of water, hot, cold and "purified" water. Note the "purifying filter" above the cold water "spicket." Photograph by courtesy of Crane & Co.

Water Softening Plants



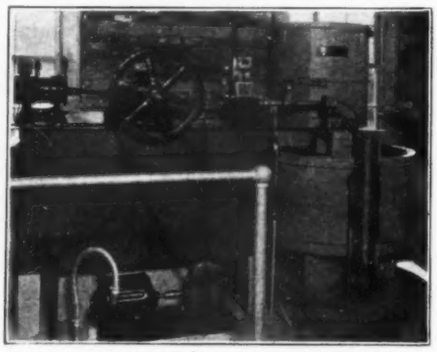
An Early Continuous Water Softening Plant

Offered by the American Water Softener Co. —American pioneers in water softening. Note the filtration upward through excelsior and the down draught center pipe and mixer. These compact plants did a remarkable job when properly controlled. Sand filters were subsequently added where desirable.



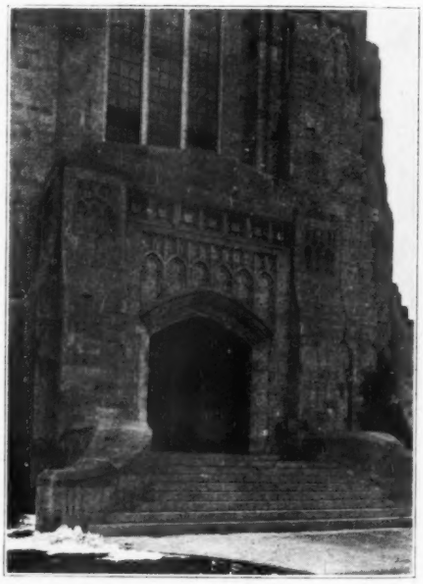
Chemical Proportioning Equipment of Early Design

The American Water Softening Co.'s tipping bucket scheme raised a valve on an adjoining chemicals reservoir at each tip. The dosage was regulated by varying the concentration of chemical solutions or the valve setting; the rate of application by the frequency of bucket tips. Note the cross-slat mixer beneath.



Modern Chemical Proportioning Device

The newest scheme of the American Water Softening Company is the Electro-Magnetic Proportioner. Actuated by electrical contacts made by a revolving type water meter, in the raw water line, an electro magnet is actuated and drops the floating solution take-off pipe within the chemical tank in direct proportion to the rate of water flow. The length of stroke is adjustable to vary the dosage—i. e., the speed of lowering of the take-off pipe.



The Newest in Municipal Water Softening Plants

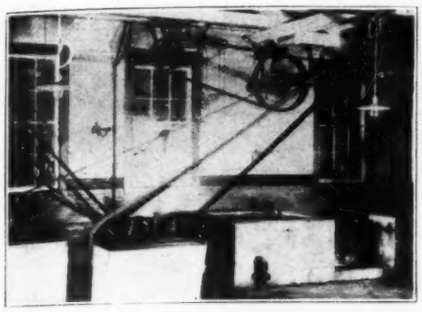
Main entrance to the new plant of Fort Wayne, Ind., placed in operation in late 1933.

▼

THE INTRODUCTION OF BATHS IN GREAT BRITAIN.—The earliest reference to the need for public works in Great Britain is a quotation from Tacitus, who, in about A. D. 78-85, wrote:

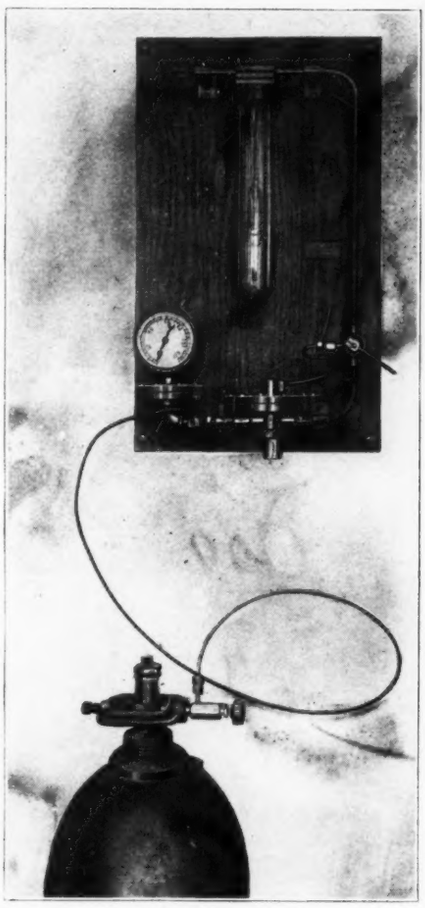
"In order to get the people of Britain, who were always ready for war, accustomed to peace and quiet, Agricola encouraged them to build temples, market-places and houses. . . . They took to using baths like the Romans and having fine dinners like ours; and soon the Britons thought themselves quite civilized."

Development in Chlorination Equipment



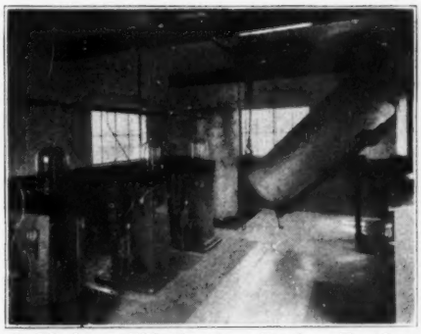
The First "Sterilization Plant" on a Domestic Water Supply at Boonton, N. J., 1908

This "Hypo" plant using bleaching powder was installed on the Jersey City (N. J.) supply—under the direction of Hering and Fuller, engineers. It was put into service Sept. 26, 1908, by the late George A. Johnson (then a member of the firm), who was in charge of design and operation of this plant. Photograph, by courtesy ofg W. Donaldson, Fuller & McClintock, engineers.



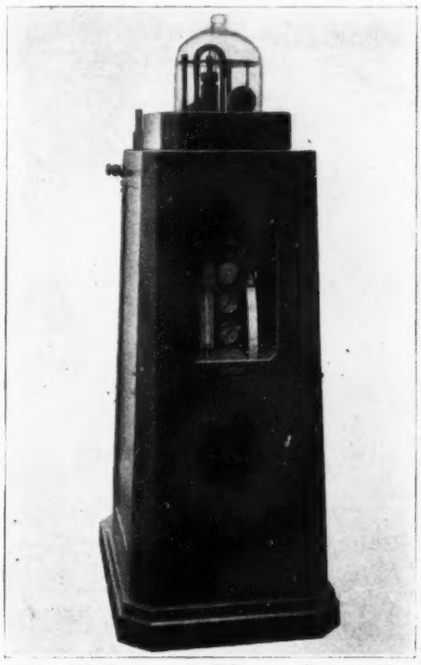
"Number 000001" Wallace and Tiernan Chlorinator of 1913

Was installed by M. F. Tiernan to "disinfect" a part of Jersey City's (N. J.) water supply at Dover, N. J., on Washington's Birthday, 1913. Making chlorinator sales was tough-going in those days.

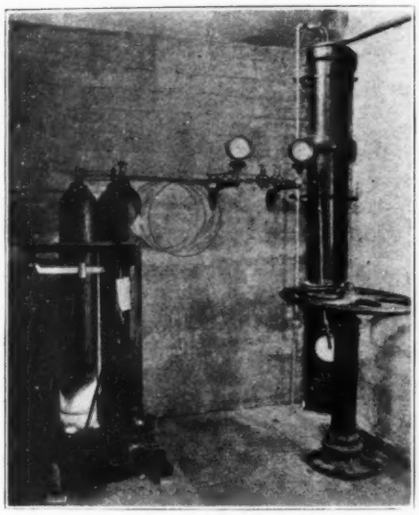


A Modern Chlorination Station Employing the One Ton Chlorine Container for Use in Large Installations, Los Angeles, Calif.

Special equipment designed for handling containers through casement window.

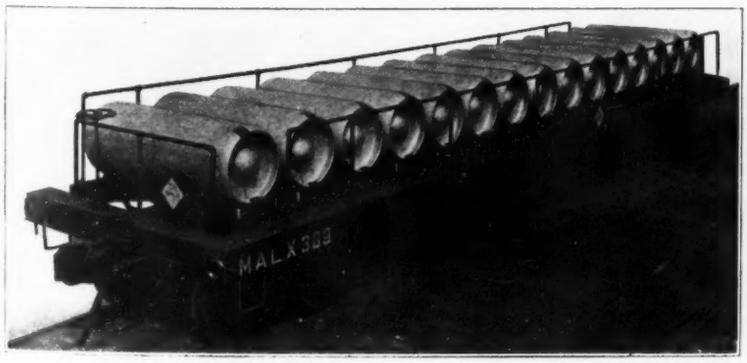


The Wallace and Tiernan "Master" Chlorinator of 1934



The First Commercial Chlorinator—1912

Installed by Dr. W. Ornstein, of the Electro Bleaching Gas. Co., in the Wilmington, Del., Filtration Plant. Was the "daddy" of the "E.B.G." chlorinators.



The Modern Container for Chlorine

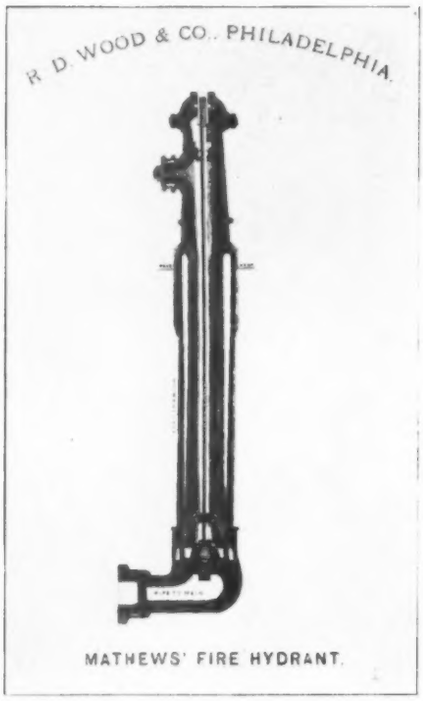
The one-ton chloride container (cylinder) was developed by Mathieson Alkali Works. Holding patents covering this revolutionary container, the company has allowed free-trade in both container and multi-unit car. It was this style of chlorine shipment that simplified chlorination practice and made it economically more attractive—especially in prechlorination of water and sewage treatment.

Wallace and Tiernan's new "Visible - Variable" Vacuum Chlorinator—a— 750-lb. per day capacity variable-rate machine is without question the modern chlorinator; a representative product of 21 years of chlorinator manufacture.

The First Cylinder of Liquid Chlorine Made Commercially in America Was Produced at Niagara Falls, N. Y., by the Electro Bleaching Gas Co. in September, 1907

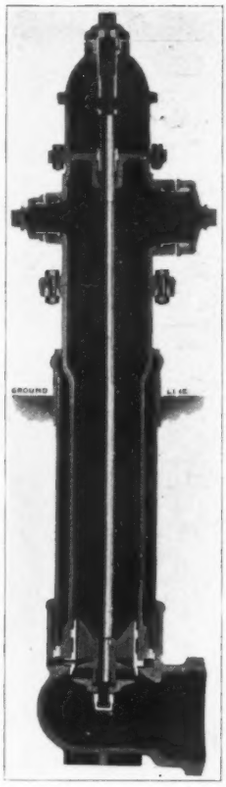
E. D. Kingsley, president of the company, toured the country with this package to demonstrate this new and strange material, which has since played such an important part in industrial enterprise and sanitation.

Evolution of Fire Hydrants During Three-Quarters of a Century



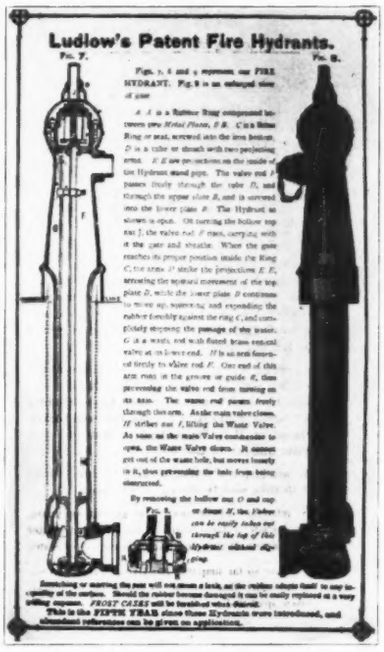
"Mathews' Patent Fire Hydrant"—(Patented in 1858 *by S. R. C. Mathews and by* 1886 *Used by More Than Half the Cities in the United States*

In 1803 *Frederick Graff, chief engineer, Philadelphia Water Works, introduced the idea of the "stand-pipe type" of fire hydrant with drip valve at the bottom. The Mathews' hydrant followed, then later the "double-valve" Mathews' hydrant, both of which closed with the pressure just as does the Mathews hydrant of today. The above illustration is a poor reproduction of a remarkable steel engraving taken from R. D. Wood Co.'s early catalog.—Editor.*



R. D. Wood and Co.'s 1934 *Model of Mathews' Patent Fire Hydrant*

Featuring the removable barrel; non-leak compression type valve closing with the flow.

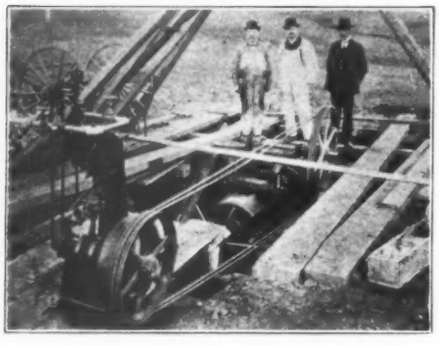

Ludlow's Patent Fire Hydrants.

Ludlow's Patent Fire Hydrant of 1873

The illustration is a reproduction of a page from a leaflet put out by Ludlow Valve Manufacturing Co., of Troy, N. Y., in 1878, *whose "references had extended over some seventeen years" prior thereto. The hydrant was in its fifth year of production and at that time Ludlow considered left-handed opening "an unfortunate though general custom."*

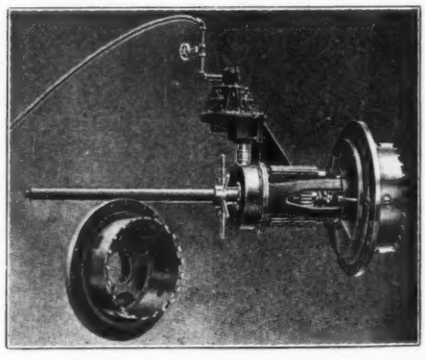
Ludlow's 1934 *Hydrant—the "Ludlow Diamond"*

Radically different from the hydrant of 1873, *the water is shut off by a gate operating against the flow; has been beautified and has aluminum trimmings.*



An Early Tapping Machine—Atlanta, Ga., 1905

An A. P. Smith machine making a 36-in. cut in a 36-in. main. The central figure in the group is "Bill" Rapp, who was foreman and now superintendent of water works at Atlanta.



A 1934 *Model A. P. Smith Power Tapping Machine for Large Mains*

Did Richmond, Va., Have the First Filters in America?

What is believed to have been the earliest installation of sand filters, for purifying a municipal water supply in America, were those built for Richmond, Va., in 1832.

On July 24, 1830, one Albert Stein, an engineer of ability, was commissioned to build a "Watering System for the City of Richmond, Va." Recently his original (hand penned) report covering the project has come to our attention, in which Mr. Stein states:

"The filter is 22 feet 6 inches long and 16 feet wide. The water is made to percolate upwards in filtering through a body of gravel and sand and whenever the quantity of pure water falls short, by the lodgment of sediment amongst the gravel and sand, the water is made to enter at the top, and in passing downwards with considerable force, carries along with it the sediment into the receiver, from which it is carried off through the ascending main by means of a branch pipe with a stopcock attached to it."

"It is doubtful with me, whether the size of the present filter is sufficiently large to produce the required quantity of pure water. This is the first filter I have ever formed upon a large scale and I believe is the only one formed in the United States for the purpose of producing pure water for the supply of a town."

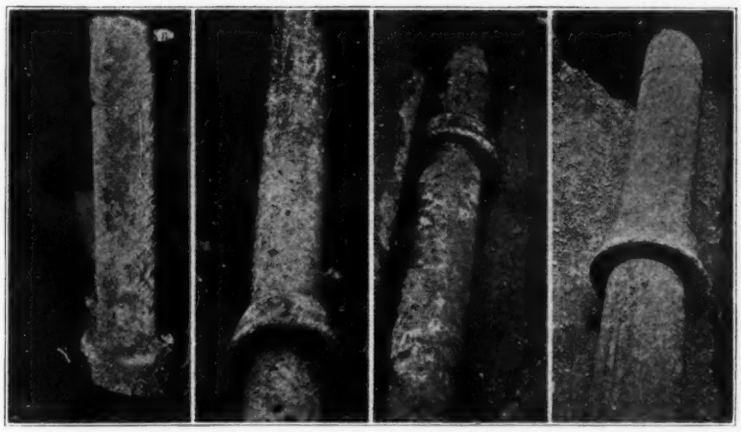
Like Mr. Stein, we believe the Richmond filter to be the first in America "formed for the purpose of producing pure water for the supply of a town," but stand open to a correction.

The muddy "James," as the river was known, has never been kind to filters and the Richmond filter, like other early installations, was doomed to failure as a rapid rate unit—operating without the aid of coagulants of any kind.

Cast Iron Pipes

The Great-Great-Grandfather of Cast Iron Pipes—270 Years "Young"

The oldest authenticated record of cast-iron pipe use shows it (above picture) to have been installed 270 years ago at Versailles, France (1664), before America had begun cutting down trees to make its log water pipes. The Cast Iron Pipe Research Association would say that the Versailles pipe is "270 Years Young" because it is still in service and has a long life ahead of it yet.



Some of the Oldest Cast Iron Pipes in Service in America

Left to right—Philadelphai; St. Louis; Lynchburg, Va.; Richmond, Va. Philadelphia was the first to install cast iron pipe, some now in service being 112 years old; Richmond was next (1830)—the above pipe having been in service for 104 years. All of the above pipe has been in continuous servcie for more than 100 years. Note the tapping bands (swells) on the Philadelphia and Richmond pipes.

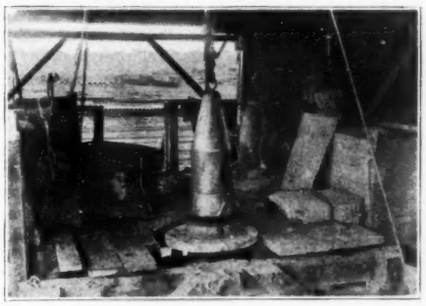
Evolution of Cement Lined Pipe

The "Ancestor" of Cement Lined Cast Iron Pipe

It was this pipe which attracted the attention of J. E. Gibson, engineer and manager, Charleston, S. C., Water Department to the probable value of lining cast iron pipes with cement. The outcome was the birth of cement-lined C.I. pipe in 1922. The above picture is of a section of 4-inch pipe manufactured by the American Pipe and Construction Co., of Philadelphia; installed at Norfolk, Va., in 1909, and removed after 22 years of service. It consists of two "stove pipes" (wrought iron) between which the filling of natural cement was poured. The interior shell was then lined with ⅝ inch of the same cement. Mr. Gibson explains the cracks and spalling to be due to 8 years of drying out in his office and handling. Its sustained carrying capacity interested Mr. Gibson—result, cement-lined pipe.

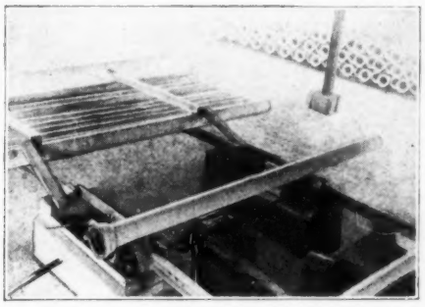
A Section Cut from the First Length of Cement Lined Cast Iron Pipe Made in America—1922

Made to meet Mr. Gibson's specification, the above section of pipe was the first to be produced by the American Cast Iron Pipe Co. at its Birmingham plant in 1922. It was lined by the projectile or "bullet" process. The mortar was Louisville cement and sharp clean sand, 3 to 1 ratio. Thickness—6 in. lining, 3/16 in.; 16 in. lining, ¼ in.



First Scheme Developed by ACIPCO for Producing Cement Lined C. I. Pipe

The pipe placed in exact vertical position and centered; the bullet lowered to the bottom; a measured quantity of mortar poured in. As the bullet was raised cautiously and slowly the lining was literally squeezed onto the walls of the pipe. The process was developed by the American Cast Iron Pipe Company in 1922 at Birmingham to supply lined pipe to Charleston, S. C.



Modern Method of Cement Lining of Pipe at the ACIPCO Plant

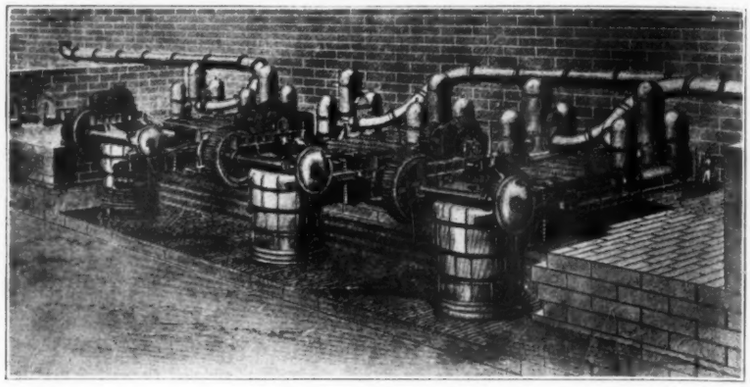
The present method of lining pipe is by the spinning (centrifugal) process. The cement is applied evenly from a spout traveling the length of the rapidly spinning (revolving) section. Centrifugal force does the lining and smoothing up, leaving a dense structure at the surface, the coarser particles being forced to the pipe wall.

Acknowledgment—The photographs of cement lined pipes and original method of lining were supplied by Mr. James E. Gibson of Charleston, S. C.; those of the old and new methods of lining by ACIPCO.

Water Pumps of Yesterday and Today

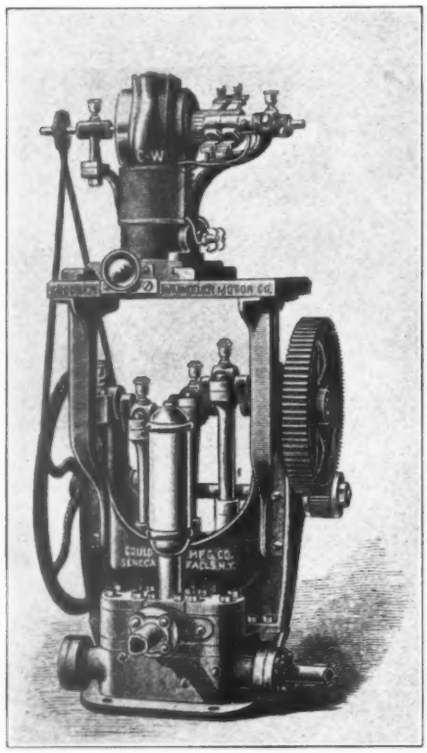
The First American Water Works Pumping Station—Bethlehem, Pa.

The first public water supply in America was the gravity supply of Schaeffertown, Pa. (1730). The first water works system involving pumps was started in 1754 at Bethlehem, Pa. The water was raised about 70 feet from a spring to wooden tanks on a hill. The distribution pipes were bored hemlock logs and the system went into operation June 27, 1855.



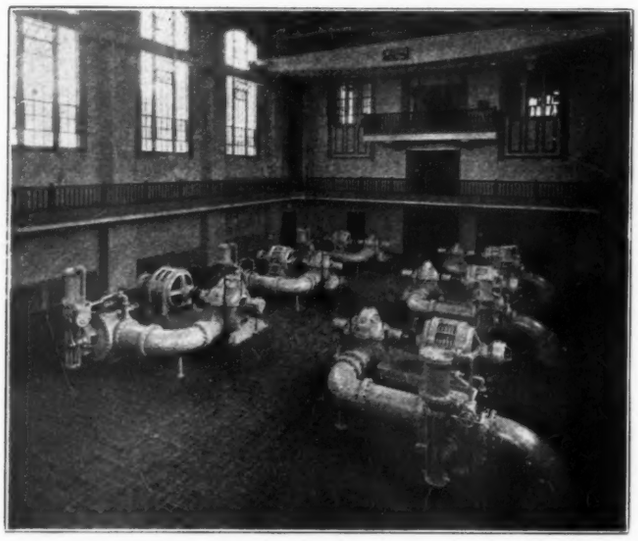
Fairmount Pumping Machines, Philadelphia Water Works—1851

Installed in 1851 by R. D. Wood & Co., of Philadelphia, Pa. Later water works installations included Montreal, Can.; Augusta, Ga.; Watertown, N. Y.; Willimantic, Conn.; Richmond, Va.; Manchester, N. H.; Wilmington, Del.; Millville, N. J.; Lynchburg, Va.; Cohoes, N. Y.; Lancaster, Pa. Few know that R. D. Wood & Co., established in 1803 as "Engineers, Founders and Machinists," were at one time pump and turbine manufacturers. Their turbines were famous for their glass suspension bearings.



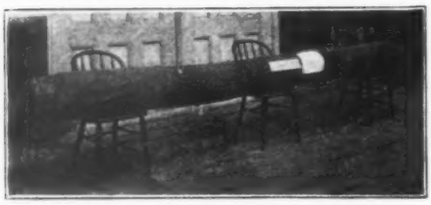
Thought to Be the Earliest Application of Electric Motor Pump Drive—1889 or 1890

Goulds Triplex Pump with Crocker Wheeler Co.'s Motor. Point of installation not definitely known. Slightly earlier a crude motor is used to drive a mine pump.



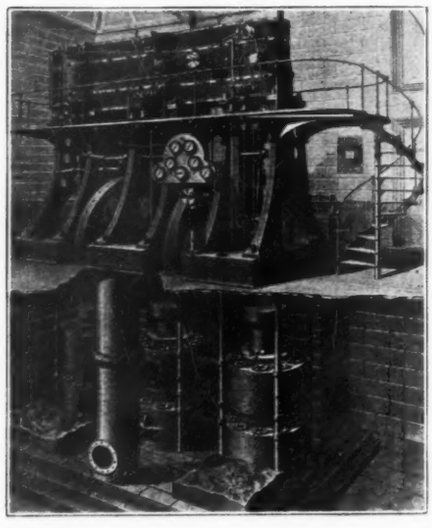
The Modern Motorized Pumping Station of 1934

The Fort Wayne, Ind., station which was placed in operation in late 1933.



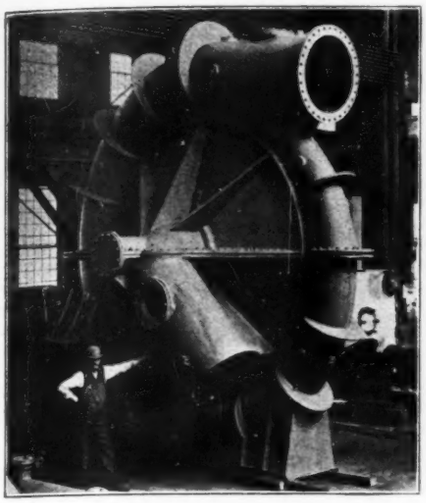
One of America's Oldest Water Pipes

Bored hemlock logs were used in the Bethlehem, Pa., distribution system in 1754 Cast iron pipe began to replace wood pipe in England about 1800 and was tried at Philadelphia, Pa., in 1804.



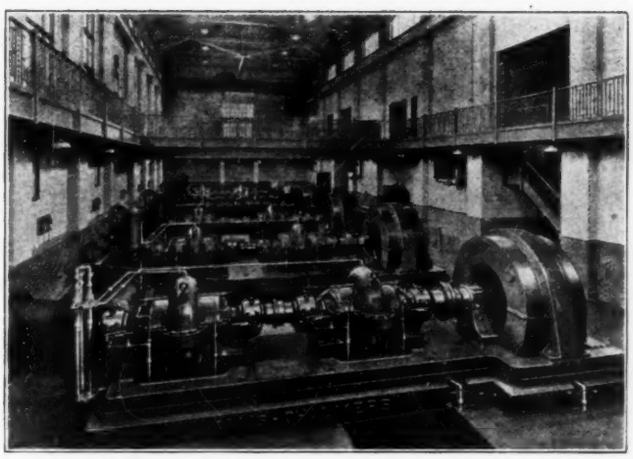
The World's First Triple Expansion Pumping Engine—1886

Was designed and built by Edw. P. Allis & Co. (now Allis-Chalmers Co.) for the Milwaukee Water Department. Capacity 6 mgd. against 150 ft. head. Prior to that (1875) the company had installed its first beam type compound pumping engine in Milwaukee.



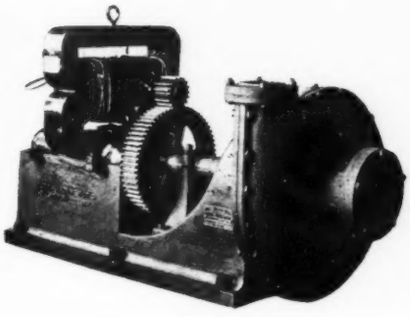
The First Centrifugal Water Pump Produced by Allis-Chalmers—1907

The earliest centrifugal pump built by Allis-Chalmers was that of 1884 (see Sewage Pumps). The above 35 mgd. centrifugal pump was built for the Pittsburgh Filtration Plant in 1907. It was driven by a steam engine at 115 r.p.m.



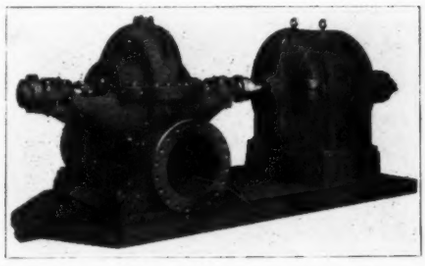
Allis-Chalmers' Most Modern Installation Is Also at Pittsburgh

The new Brilliant Pumping Station is equipped with six units of two pumps (series connected) in each. Combined capacity is 160 mgd. against 365 ft. head.



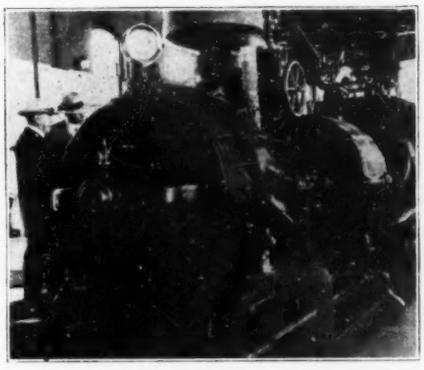
An Early Model of Motor Driven Centrifugal Pump—1896

Thirty-eight years ago Morris Machine Works built two pumping units for the City of Jacksonville, Fla. The antique motor and gear drive indicate its age. It had a 4-inch side suction and remained in service for about 35 years.



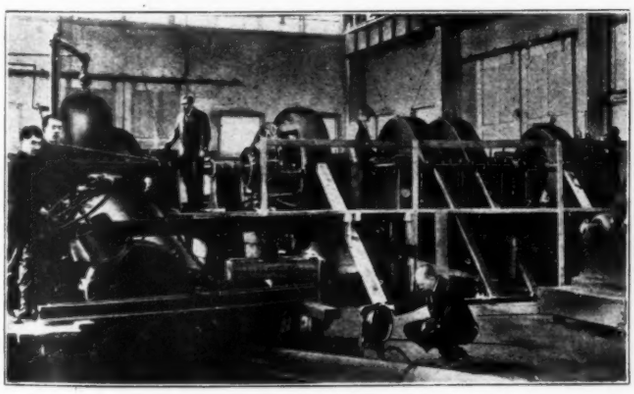
A 1934 Model of a Morris Centrifugal Pump

Double suction and horizontally split case are two of the many features of this 1934 product of Morris Machine Works.



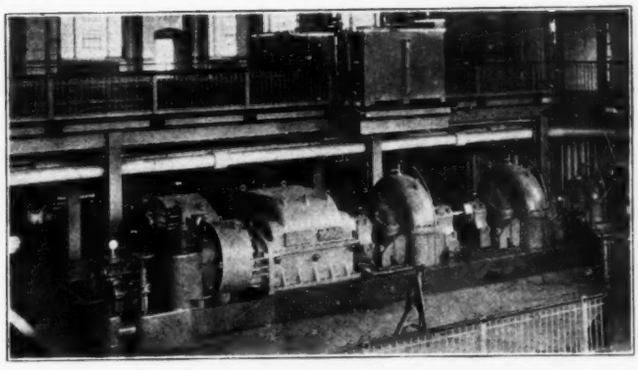
The First Steam Turbine (De Laval) Built for a Water Works—Atlantic City, N. J.—1910

Single stage unit (9,000 r.p.m.)—still serviceable.



The First Large Geared Turbine Driven Centrifugal Pump Built in America—1913

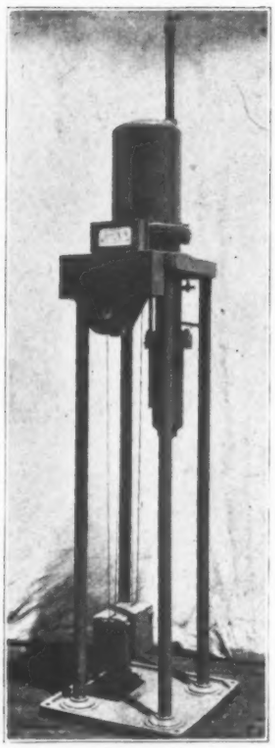
Was installed at Pittsburgh, Pa. (Ross Sta.) in October, 1913, by the De Laval Steam Turbine Co. It was this unit that placed centrifugal pumps in a position to compete economically with the majestic triple or quadruple expansion pumping engines. The large capacity double-helical speed reducing gears played no little part in making this combination of high-speed turbine and slow speed pump practical.



High Pressure De Laval Units of Today—(Believed to Be the Largest Turbine Driven Pump Units Yet Built)

The two units of 60 mgd. capacity against 360 ft. head are located in the St. Louis (Howard Bend) Plant. Steam pressure supplied the turbine is 325 lbs. gage at 245° F. superheat. Turbine speed of 3,460 r.p.m. is converted to pump speed of 596 r.p.m.

Meters and Gauges

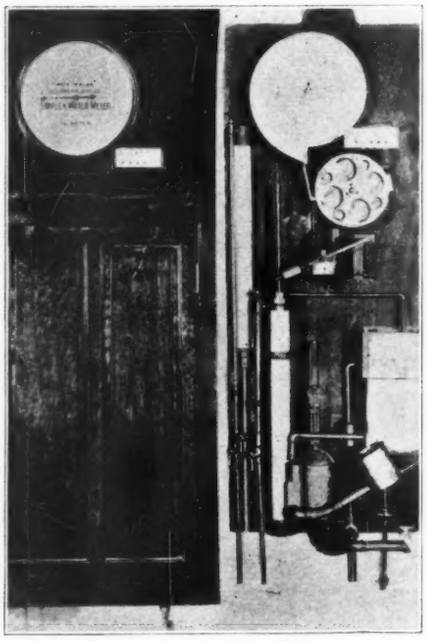


The Earliest Model of Builders Iron Foundry Venturi Register — 1892. Was Installed with the First Venturi Tube at the Belleville Plant of East Jersey Water Co.

This instrument gave total flow only and registered at intervals of 10 minutes. No record was produced other than that in the meter reader's record book.

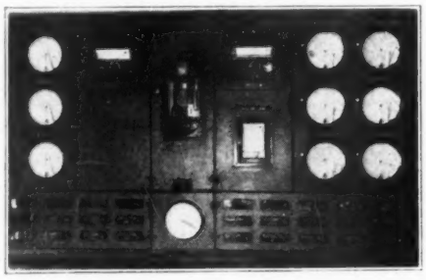
The 1934 Model of Builders Iron Foundry Venturi Instrument

Totalizes continuously; indicates; records. Capable of the double duty of measuring and recording flows in and out of storage reservoirs floating on the system. Provides a chart record showing direction of flow; rate; duration. Totalizes on separate counters.



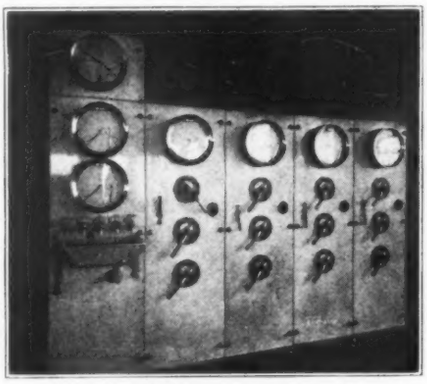
Simplex Meter of 1905—Installed for the Tipton Water Company at Tipton, Pa.—Case on Left; Mechanism on Right

Modern Simplex Venturi Recording Instrument—Indicating Recording and Totalizing Register



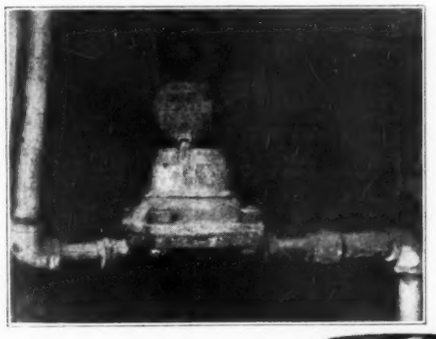
Modern Instrument Panel with Foxboro Gauges

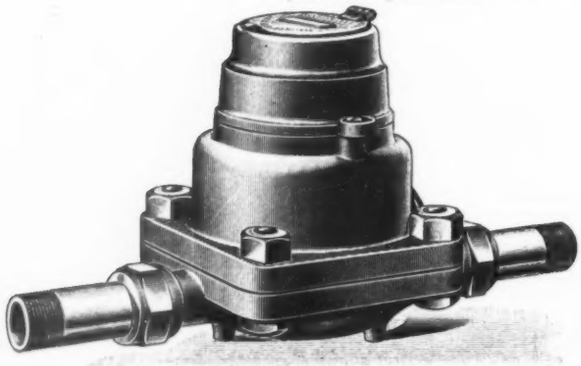
At the Westchester County Sewage Treatment Works, Yonkers, N. Y. Instruments flush mounted on ebony asbestos wood paneling. Modern Simplex Meter Register and Recorder in center.



Early Installation of Foxboro Gauges

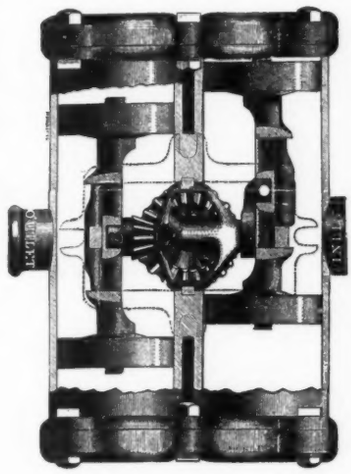
At the Kenneth Square (Pa.) Pumping Station. Instruments project into room and old-fashioned pens used.





Most of the Improvement to Domestic Water Meters Has Been on the Inside with Little Change in Exterior

The illustration on the left is from an old woodcut of an early Buffalo (Niagara) meter; that on the right is the Buffalo meter of today. Above is shown an installed meter (Niagara No. 130) which has been in service since 1893.



The Double-Acting Piston Type Meter of 1868 (Picture at Left)

The Ball and Fitts meter, manufactured by Union Water Meter Co., of Worcester, Mass., was introduced in 1868; used a rotating cone-shaped valve and double-acting piston displacement system operating the register through a crankshaft. Water was measured by the number of displacements of the piston—a calibrated pump operating in reverse.

The Modern King (Union) Disc Meter

The newest Union meter is said to be the most perfectly frost-protected meter. Disc is provided with a hard rubber roller on the outlet side of disc slot. "Everdur" noncorrodable metal and Umelite (composition) is used in the gear train and for other parts moving in contact. Intermediate gear train is oil enclosed.

Elevated Tanks

Reminiscent of Yesterday, but Made of Good Stuff

A wrought-iron standpipe of 1886 which is still in use after practically half a century of service and no repairs. At Charleston, S. C., an old wrought iron standpipe, having outlived its usefulness as such, has been cut down, moved to the filtration plant and converted into a wash water tank to serve this and other generations to come.

An Early Elevated Water Tank—1894

At Fort Dodge, Ia., the Chicago Bridge and Iron Works made its first installation of a municipal elevated tank in 1894. Capacity, 104,000 gals.; height to top, 116 ft. Is still in service.

A Modern Elevated Tank, at Evanston, Ill.

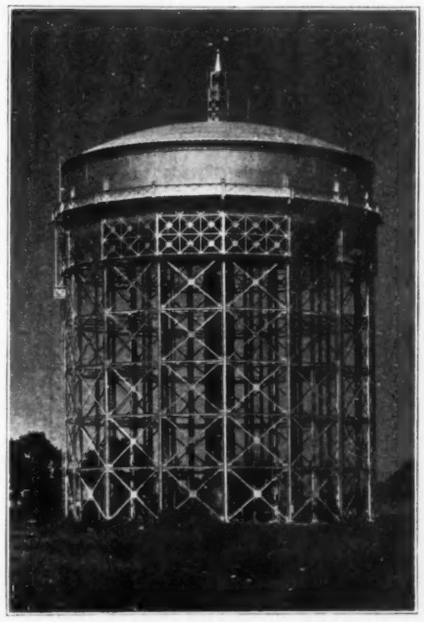
Capacity 1,500,000 gals.; height to bottom is 92 ft. Built by Chicago Bridge and Iron Works.

Another Early Installation of Elevated Water Tank—1897 (Left)

This first tank to be installed by Pittsburgh Des Moines Steel Co. for a municipality (Scranton, Iowa) had a capacity of 40,000 gals.; tower height, 100 ft. Is still in service.

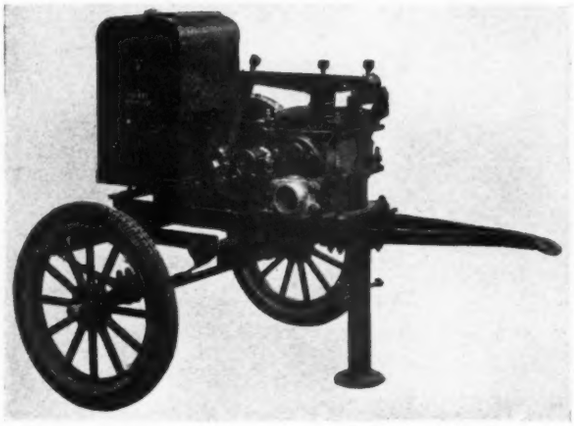
Another Style of Modern Elevated Tank at Milwaukee, Wis. (Right)

Capacity 1,500,000 gals.; diameter, 79 ft.; height to top, 167 ft. Built by Pittsburgh Des Moines Steel Co.

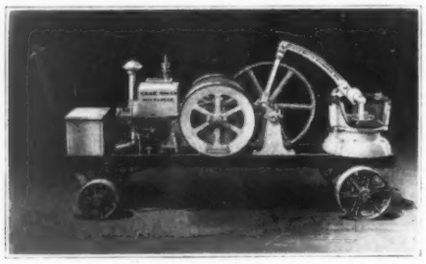


Diaphragm Pumps

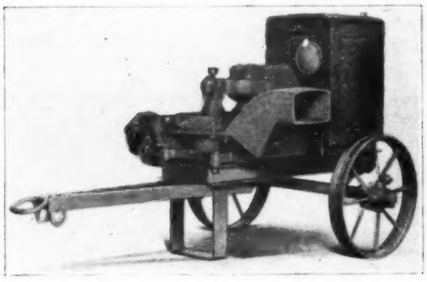
At Work with an Early Edson Hand Pump of 1900
Jacob Edson invented the diaphrgam type of pump in 1876*—then called a life-saving pump for ships.*



Modern Edson Engine Driven Diaphragm Force Pump with Trailer Mounting on Steel Wheels with Balloon Type Tires

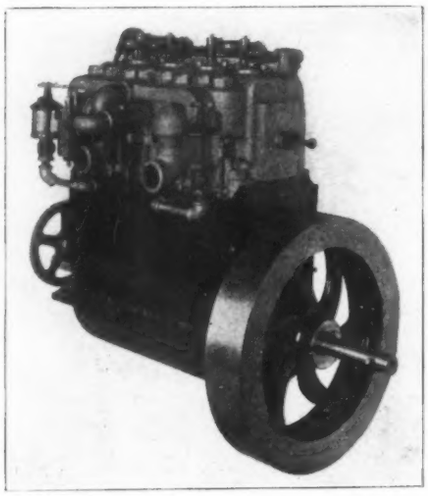


The First Diaphragm Pump Built by C. H. and E. Mfg. Co., Milwaukee, Wis. Powered by Kerosene Engine



Modern "C. H. & E." Pump, Powered by Le Roi Engine with Worm Gear Drive

Gasoline Engines

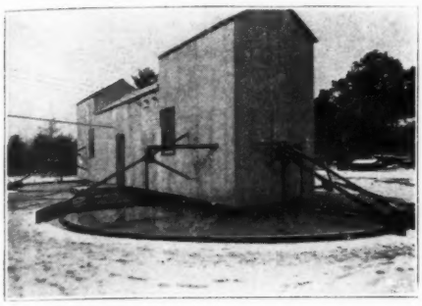


Buffalo Gasolene Motor Company's First 4 *Cylinder* 1898 *Model of Gasoline Engine*
It was 4*-Cycle,* 3¼*-in. bore and* 5*-in. stroke; had suction intake valves and cam operated exhaust valves. Cylinders were cast embloc; make and break ignition; mixing valve vaporizer. Crank case was enclosed in sheet iron.*

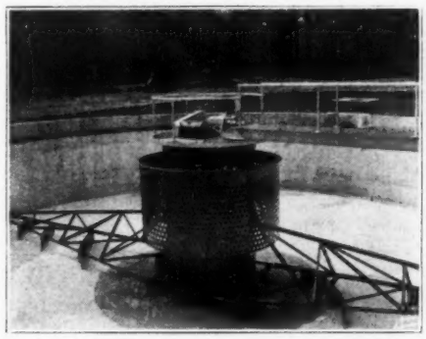
The 1934 *Model of an* 8 *Cylinder Buffalo Engine*

First Public Water Supplies.—The first public water supply in the United States was at Boston, Mass., in 1652. Schaefferstown, Pa., had a public water supply about 1732, and Bethlehem, Pa., in 1761. The last mentioned works were started in 1754 and finished seven years later by Hans Cristopher Christiansen, a millwright.

Sewage Clarification and Sludge Handling

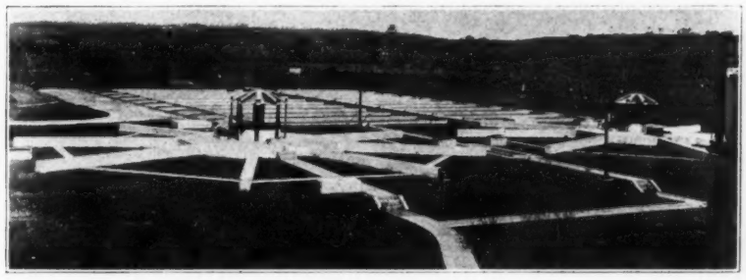


Dorr Co.'s First Clarifiers in the Sanitary Field (Left)
Installed at Springdale, Mass., 1919.



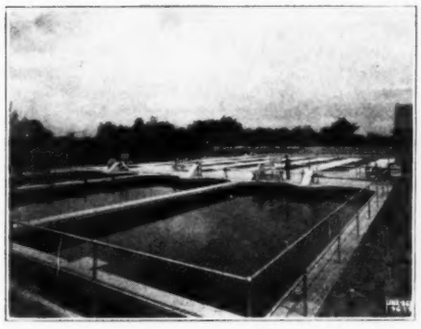
The 1934 Model Dorr Center Feed and Center Drive Clarifiers
Installed at Birmingham, Alabama's New Chemical Sewage Treatment Plant (1934).

Early Type Open Top Sludge Digester
Installed at Vero Beach, Fla., 1926, by Dorr Co.



Dorr Co.'s 1934 Model (Type K) Sludge Digester with Gas Collector
Installed at Birmingham, Alabama (Ensley Plant).

The Earliest Link-Belt Sludge Conveyors, 1921
Installed at the Gastonia, N. C., Activated Sludge Plant, designed by Wm. B. Piatt, engineer. Equipment was very much the same as Link-Belt mechanism used in coal washeries for continuous solids separation.



The Latest Model in Link-Belt "Straight Line" Collectors
This installation, at the Springfield, Ill., Sewage Treatment Works, incorporates many important improvements developed since 1921, including peaked cap babbit bearings and pivoted scraper blades now used on the submerged mechanism.

Early Stoneware Pipes

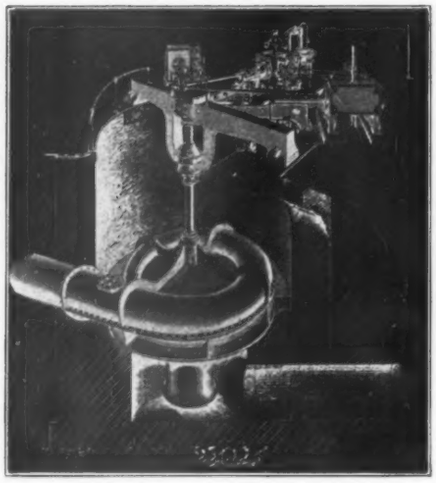
An interesting advertisement concerning stoneware pipes, printed in the Aug. 16, 1727, issue of the London Evening Post, appears in the April-May, 1934, Official Circular of the British Water Works Association.

"By Publication made in the Evening Post, the 22d of July 1725, setting forth that Mr. William Edwards of the Town of Monmouth at that time obtained a Patent under the Great Seal of England, for the sole making and vending of Water Pipes made in Clay; Which Undertaking since that time is very much improv'd by the above-mentioned Pattentee in the making and joining the said Pipes, that they serve in all Cases, and to all uses as Lead Pipes now do, and have lately found out and promoted the way now us'd of working the said Pipes up in the inside of the Walls of Houses and Buildings, and affixt to the Outsides of such Walls, from the lower Floor to the uppermost Floor, and discharges the Water from the Roof and Gutters of such Houses as effectually as any Pipes made in Lead or Wood, and are to be sold for one sixth Part in value to those made in Lead. They are to be seen plac'd in their Work in the new Buildings in Welbeck street near Oxford Chaple. The corner House adjoining the Golden Faulken Inn are lodg'd a Quantity of such Pipes to serve that Quarter of the Town. Any Inland County that has good Clay to make such pipes, is to be Farm'd or one or two Shares of the Patent to be sold. All Letters sent are desir'd to pay Postage.

These Pipes are also made and sold pursuant to the said Patent by Mr. Aaron Mitchell, Potter at Vaux Hall in Lambeth, who makes all sorts of New Fashion Flower Pots and Vauses made of fine Clay mixt with other Ingredients, curiously wrought from two Foot to four Foot and a half high, well proportion'd, and of a Freestone Colour, being the best of Ornaments for Dwelling Houses &c. and are burnt to that Degree, that they are as durable, beautiful, and neat as those made in Stone or Lead, and sold at very reasonable Prices.

N.B. The 24th, 25th, 26th, of July 1727, Mr. William Edwards of the Town of Monmouth, produc'd a Sample or Specimen of his New invented Water Pipes made of a peculiar Clay, after due Preparation becomes stronger and finer than those Bricks and Tiles form'd and made by the Romans (so remarkably good) they were two Inches Bore in the Diameter, Eight of each sort very artfully join'd together with a strong Cement or Soder made eighteen Foot in Length, the one End of which Pipes was well stopt.

Sewage Pumping Equipment

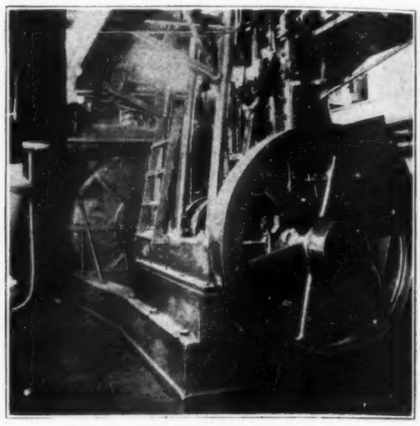


The Allis Centrifugal Pump of 1884

This interesting looking centrifugal pump was designed by Edw. P. Allis & Co. as a sewage pump. A 48x72-in. unit was installed at Milwaukee in 1884 *and later another at Boston.*

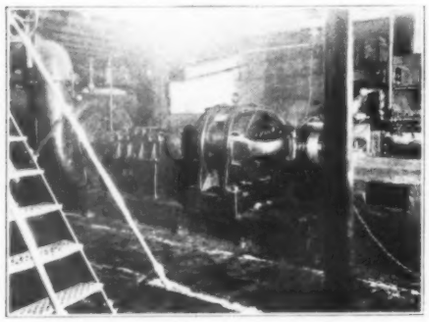
One of the Earliest Centrifugal Type Sewage Pumps—The 10*-Inch "Special Cataract"*

Built much after the principle of the paper-pulp pumps used in paper mills. This pump, installed 48 *years ago in the very center of Norfolk, Va.'s, business district, is still useful as a standby unit. Pressed into service during the storms of* 1933, *was a life-saver. Note the slow speed belt drive from a horizontal steam engine.*



An Early Centrifugal Trash Type Pump of 1900

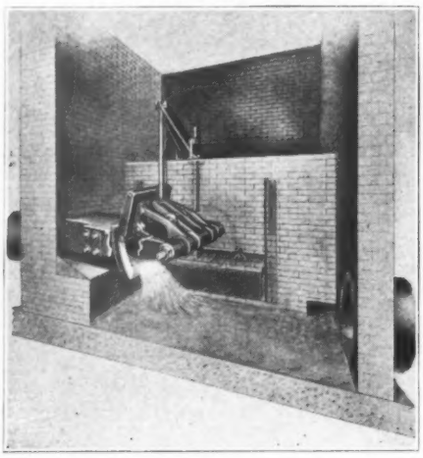
This is probably the first true centrifugal type pump built by Morris Machine Works for sewage. There were two of these Morris 20*-inch units (Neal and Sisco Patent), direct driven by a* 3*-cylinder vertical steam engine at* 150 *r.p.m., installed more than* 40 *years ago in the Main Sewage Pumping Station at Norfolk, Va.*



Modern Centrifugal Sewage Pump

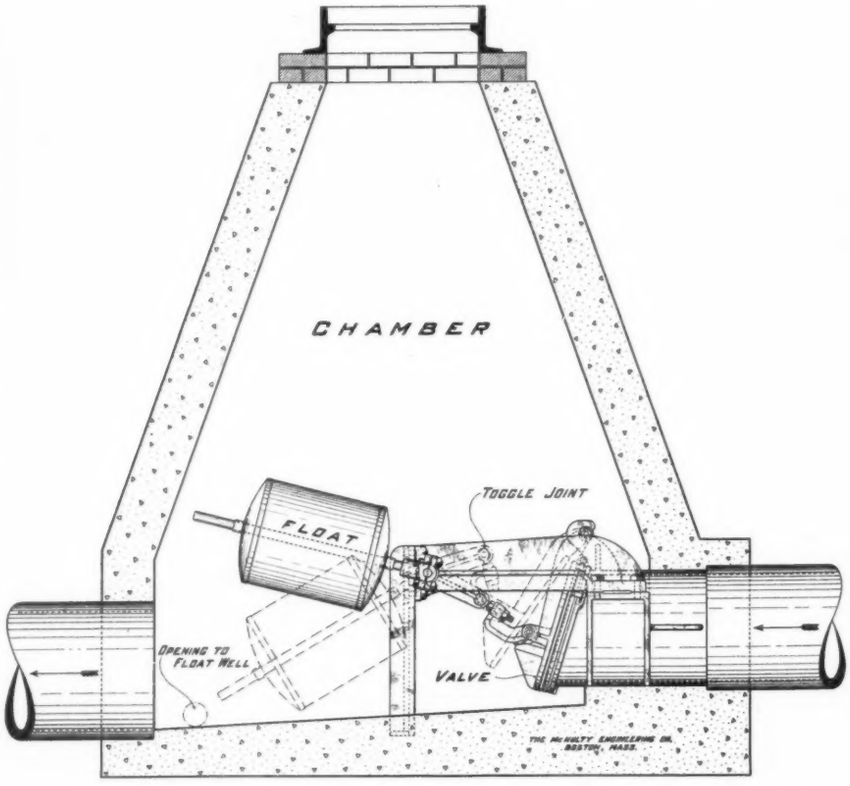
When Norfolk replaced one of the old Morris pumps, three modern electric-driven centrifugals were installed in the same pit. The new 16*-inch Morris pump (illustrated) is driven by a variable speed motor. Emergency gasoline engine auxiliary drive to the right. At Norfolk one finds practically* 50 *years of sewage pump development within a station where dependability is paramount, if costly flooding out of cellars in the business district is to be prevented. Every gallon of Norfolk's sewage and storm water must be pumped.*

Flow Control Gates



The 1934 *Model of McNulty's Automatic Toggle Shear-Type Regulator and Cut-Off*

Shown as installed on a sewer or drain; serves as a tide gate also.



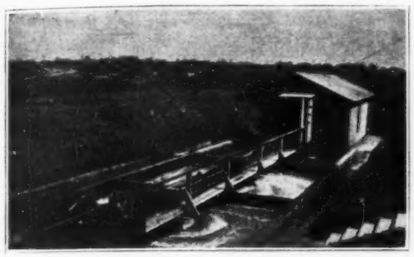
An Early Style of Toggle Flap-Type Sewage Flow Regulator and Cut-Off
Manufactured by McNulty Engineering Co. of Boston, Mass.

The Sanitary Arrangements of the Medieval Monastery

In the early days the monasteries were dependent upon wells, later supply by gravitation was arranged. In most cases the water came from springs and was collected into a conduit at some distance from the monastery. At Canterbury the water passed through five settling tanks between the conduit and the monastery, and each tank had a plug which could be withdrawn.

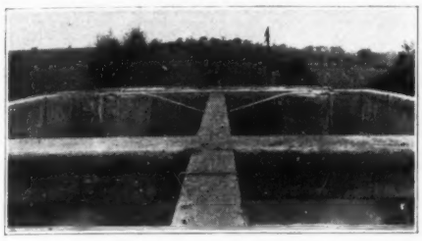
The priory of St. Bartholomew got its supply from some springs at Canterbury, and it supplied the neighboring hospital for the sum of 6s. 8d. per annum, the hospital to pay its share of the maintenance. After the hospital had used the water it went to the jail.

Mechanical Sewage Aerators

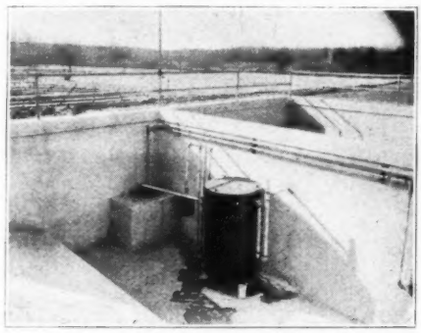


The First "Simplex" Aerators at an American Activated Sludge Plant

Installed by Simplex Ejector and Aerator Corp. (Chicago), at Colorado, Tex., in 1925. One motor and a singe line shaft with bevel gears drove all three units. Result, noise and low efficiency.

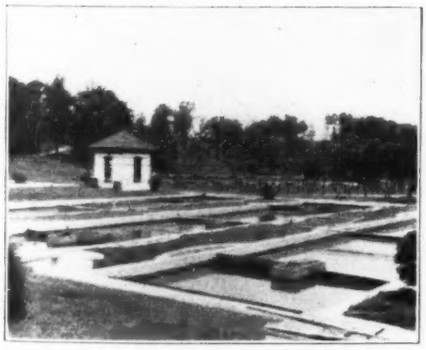


The First Twin Filter Dosing Syphons Were Installed at Lexington, Ky.'s, Sewage Treatment Plant by Pacific Flush Tank Co. in March, 1917



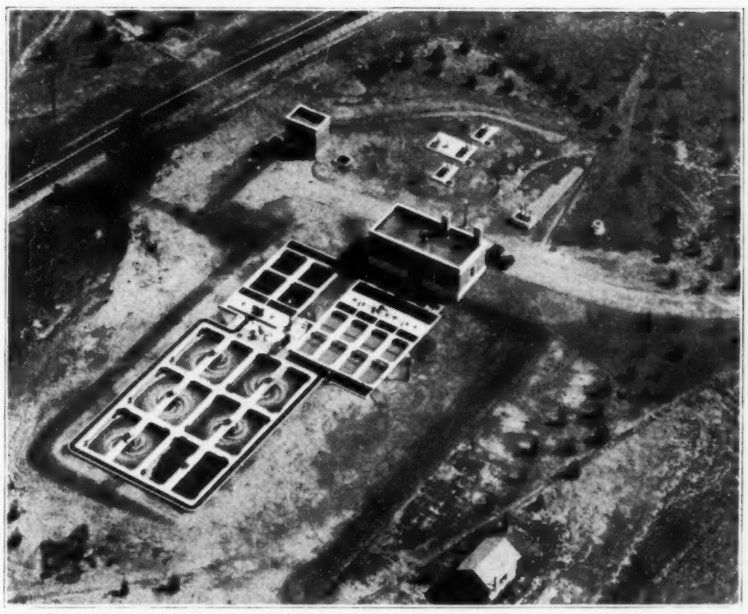
Pacific Flush Tank Co.'s Modern 24-Inch Twin Syphon at the Greensboro, N. C., Sewage Treatment Plant

Early American Imhoff Tanks and Sludge Gas Utilization



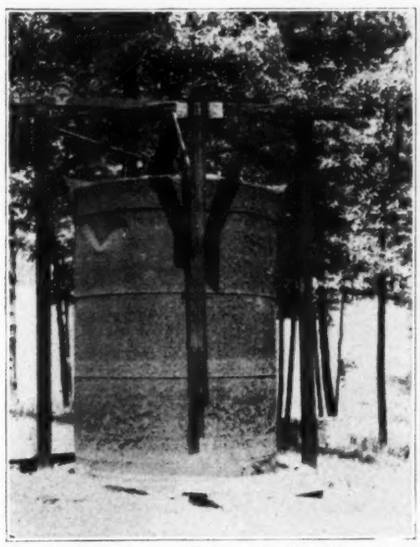
The Second Installation of Imhoff Tanks in America

The Peachtree Plant at Atlanta, Ga., continues to function, though heavily overloaded. Went into service August 8, 1912. The earliest installation was the Chatham-Madison plant in New Jersey. Both plants designed by Hering and Fuller, engineers.



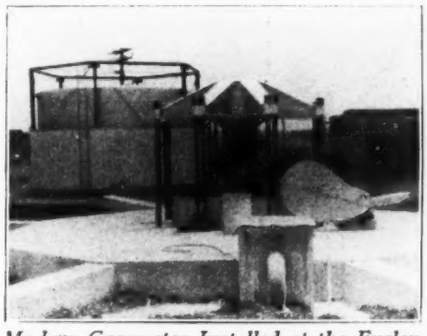
Modern Simplex Aerator Installation at Spring City, Pa. (Penhurst State School)

Each unit is now individually driven by silent worm drive gear and independent motor with increased efficiency.



At the Peachtree Plant Sludge Gas Was for the First Time (1915) Used for Heating

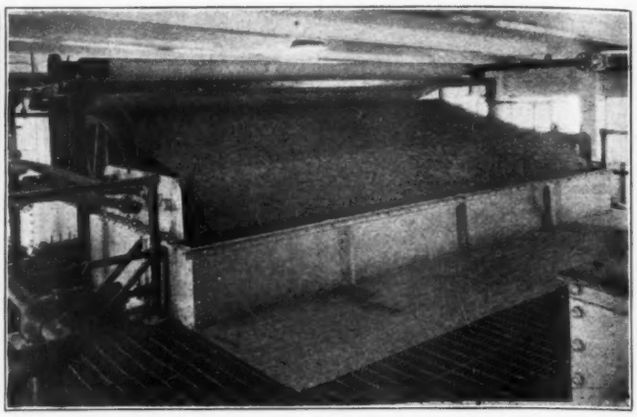
The little holder pictured above supplied gas for cooking and heating in the home of C. C. Hommon, then superintendent of Sewage Treatment Plants and now superintendent of the Canton, Ohio, plant.



Modern Gasometer Installed at the Ensley Plant Serving Birmingham, Alabama

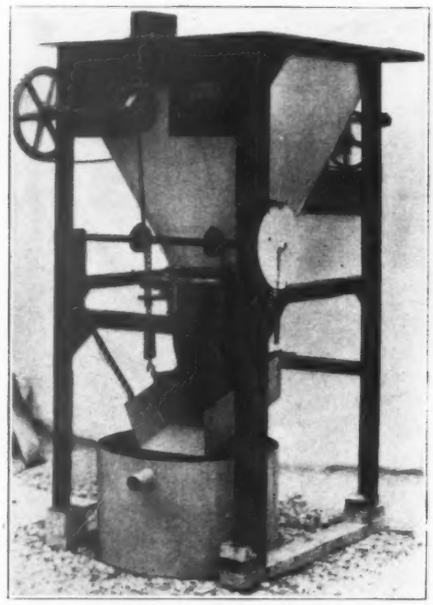
Sludge Dewatering Equipment

Sewage Sludge Filter Presses of Yesterday
Such as used at Worcester, Mass., and Providence, R. I. Shown above.

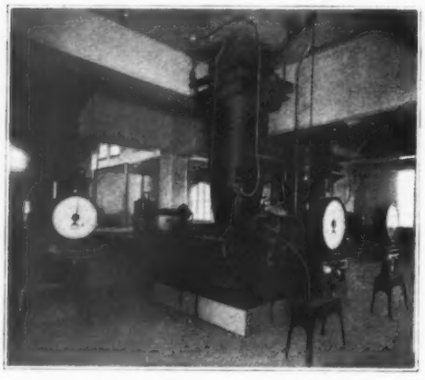


Vacuum Continuous Filters Used in Sludge Dewatering Today
Illustration is of the Rockville Center, L. I., installation which is among the most recent.

Chemical Feed



An Early Model of the Omega Dry Chemical Feeder
It was built for the Quincy, Ill., Water Softening Plant.

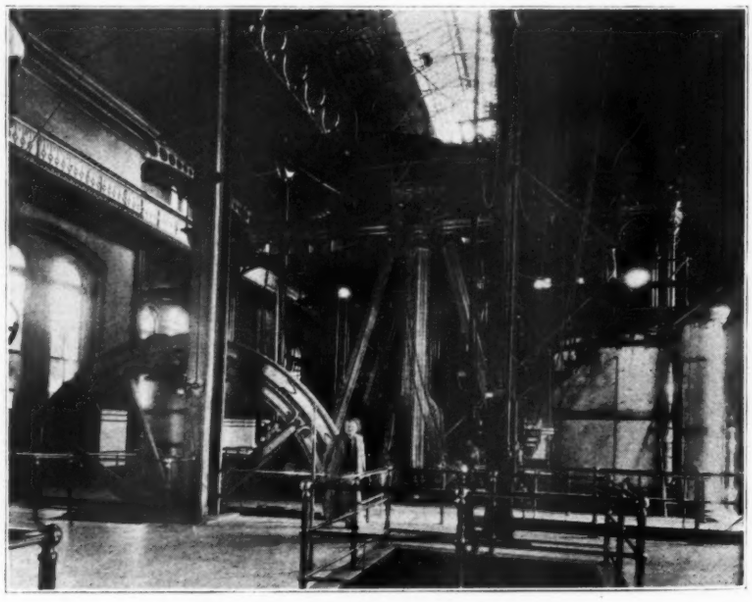


The 1934 Models of the Omega Lime Feeder—Slaker and Alum Feeder (left) Suspended on Fairbanks Scales
Installed in the new softening and filtration plant at Fort Wayne, Ind.—a 1934 model in purification works.

Cars for Transporting Chemicals

The Rubber Lined "Tank-Car" of 1920
To the Hooker Electrochemical Company goes the credit of developing the rubber lined tank for the transportation of corrosive chemicals. The above is the first successful attempt (1920) in the direction of the modern rubber lined tank car.

The Rubber Lined Tank-Car of Today
Fourteen years later: The modern rubber lined tank-car, by providing safe and economical transportation, has made the use of liquid ferric-chloride practicable in sewage treatment and sludge dewatering.



A Good Pumping Engine of Yesterday
Displaced by electrified equipment in 1930, this Hubbard & Whittaker beam engine was in continuous service at the Ridgewood, L. I., Pumping Station (N. Y. City Supply) since 1869. Mr. Henry Ford took a fancy to this historical engine; wanted it for his museum at Dearborn.

DESIGN OF SURGE SUPPRESSORS FOR CROTON LAKE, N. Y. PUMPING STATION

By S. LOGAN KERR

Water Works Engineer,
Baldwin-Southwark Corporation, Philadelphia, Pa.

THE Croton Lake Pumping Station on New York City's water supply system was installed to utilize the surplus flow of the Croton watershed by pumping it into the Catskill Aqueduct through a plate-steel conduit about 1,600 feet in length and 72 inches in diameter. The pumping head varies slightly depending upon the level of Croton Lake and the number of pumps in operation at one time, the average being in the neighborhood of 160 feet. The plant viewed from the lake is pictured in Fig. 1.

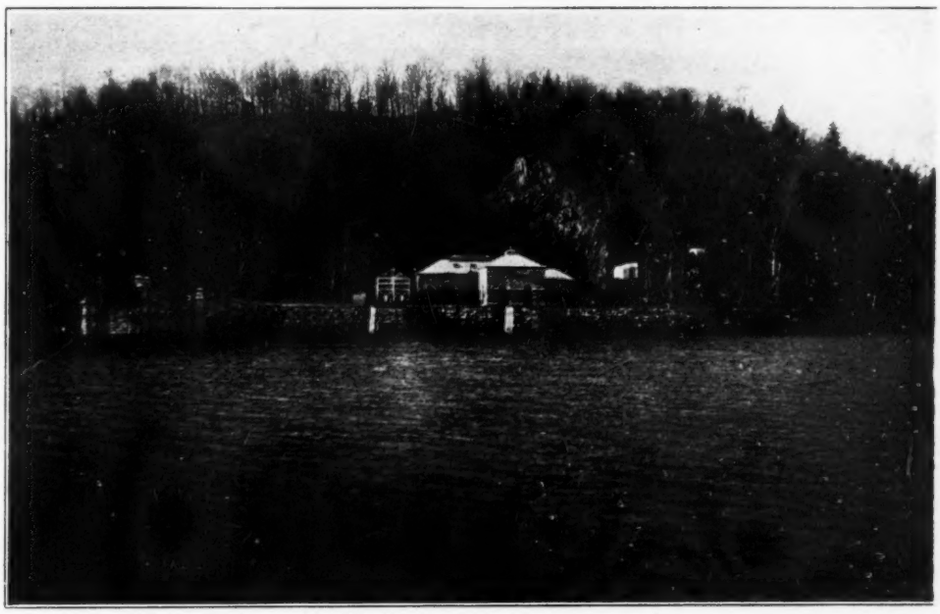


Fig. 1.—Croton Lake Pumping Plant

Three pumps are installed, each having a rating of 65 m.g.d. under a head of 160 feet, and are driven by 3,000 hp. motors at a speed of 600 r.p.m. Each pump is equipped with a Larner-Johnson Needle Type Check Valve (Fig. 2) with an inlet diameter of 36 inches and an outlet diameter of 30 inches. The valves are placed in the vertical lines leading from the pump discharge to the manifold which is located some distance above the pump room floor. The line turns through several horizontal and vertical angles to reach the Venturi meter in the main pipe line. Up to this point, the pipe has an internal diameter of about 60 inches, but after leaving the Venturi meter, the full diameter of 72 inches is reached.

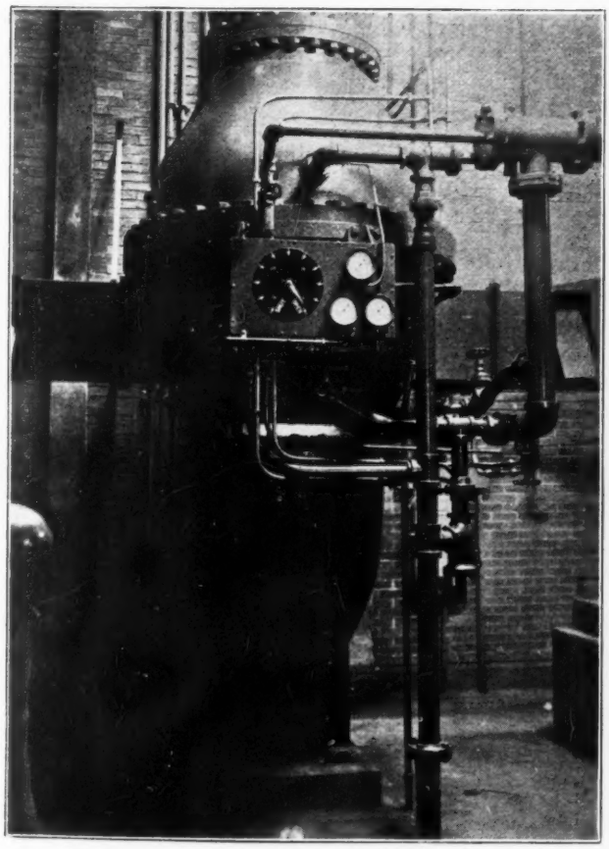


Fig. 2.—One of Three Larner-Johnson (Needle-Type) Check Valves, With a 36 in. Inlet and 30 in. Outlet

There is a sharp rise in the profile of the pipe near the pumping plant; but, for the major portion of its length, the slope is negligible until the aqueduct is approached. Thereafter, in the last portion of the line, the rise is abrupt. A siphon is arranged to discharge into a spillway chamber adjacent to the aqueduct; and, when the water is drawn down a small amount the end of this siphon is uncovered, and thus, the draining of the spillway chamber of the main aqueduct is avoided.

Purpose and Arrangement of Check Valves

The check valves are equipped with a solenoid controlled pilot valve mechanism that provides for the automatic opening of the check valve as well as the prompt cut-off of the flow in the case of a power failure on the driving motors. The pressure supply for the operation of the check valves is taken from the line an appreciable distance above the end of the discharge manifold, to avoid any high velocity disturbances and to insure the availability of a maximum line pressure for operation of the controls.

A study of the conduit and the flow conditions indicated that the rapid reversal of the water column, when

the power was cut off from the pumping unit, would introduce a problem of water-hammer; and, that accurate timing of the check valves during the closing stroke was essential in order to reduce the surge to a minimum. A number of tests, conducted during the preliminary adjustment of the valves, showed up some very interesting relations.

These tests have been described in a previous article,* but a few of the conclusions reached will be given here to indicate the conditions which had to be met.

Contrary to common belief, the water-hammer pressures increased as the rate of valve closure was speeded

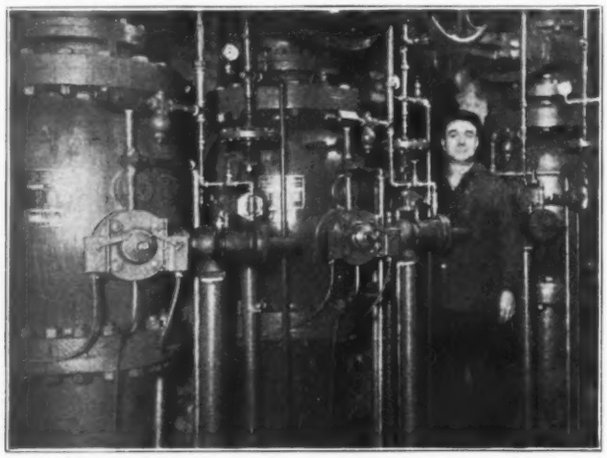


Fig. 3.—Pelton Surge Suppressors (12 in. Diameter Inlet by 16 in. Diameter Outlet) After Installation in Suppressor Chamber. Note Comparative Size of Valve

up. This condition was observed even when closure was effected within a shorter lapse of time than that required for the water column to come to rest and reverse its direction. With the shutting down of one pump the closure of the valve at the instant of flow reversal resulted in a pressure rise of more than 50 per cent of the pumping head. If two pumps were shut down simultaneously the resulting surge approached 80 per cent of the normal head, and it was considered too dangerous to try to measure the surge with three pumps tripped out simultaneously. An appreciable reduction in this surge was realized when employing slower rates of valve closure, but the pumps would reverse rapidly due to the back flow from the line. In several tests the pumps were permitted to reverse with very slow closures of the check valves, and would go from a normal speed of 600 r.p.m., forward to nearly 700 r.p.m. backward within a period of about six seconds.

Installation of Relief Valves Resorted To

To remedy this condition, it was decided to install a new type of relief valve which had been developed by the engineers of the Pelton Water Wheel Company in San Francisco. This valve had been utilized very successfully already in many cases where long pump discharge lines were involved.

In previous installations, it had been the practice to place a single surge suppressor in the pipe line to take care of all pumping units connected to the conduit. In the case of the Croton Plant, however, there was no location available at which a single suppressor of the required size could be connected to the line. Provision of a satisfactory outlet for the waste water, during the opening of the suppressor, was an important consideration to be met.

*"Water Hammer Tests in Croton Lake Pumping Plant," S. Logan Kerr, Water Hammer Symposium, American Society of Mechanical Engineers, 1933.

An investigation showed that three smaller suppressors (Fig. 3) could be connected to the 60 inch conduit between the cast iron manifold and the Venturi meter, and discharge directly downward into the old Croton Aqueduct beyond the wall of the valve house. A platform was constructed at the same level as the pump room floor and a door was broken through the wall to provide access to the suppressor chamber.

The determination of the proper size of surge suppressor was the subject of considerable study, because previous installations of this type of relief valve had been in small sizes only and usually consisted of a single 6 inch orifice valve for a group of two or three pumping units. Preliminary studies indicated that a single surge suppressor having a diameter of 24 inches would be required to keep the pressure rise from surge within safe limits. The size was determined from tests using a relief orifice adjusted to various openings and then plotting the resultant surge against the equivalent diameter of the opening for each trial.

Figure 4 shows one of these curves representing conditions when a single pump was tripped off. Similar tests were made with two and three units tripped out simultaneously and the corresponding curves plotted. All tests were checked by other test data and by the rather meager theory available and these studies indicated that a somewhat smaller relief opening would meet the conditions. When considered in the light of the local conditions at the plant, including the impossibility of installing a single valve, it was decided to utilize three surge suppressors each having a 12 inch effective diameter. These were installed as described above, and provide somewhat greater flexibility in adjustment than could have been secured with a single valve.

Interesting and Enlightening Observations

During the installation several other interesting factors were developed and the design of the controls modi-

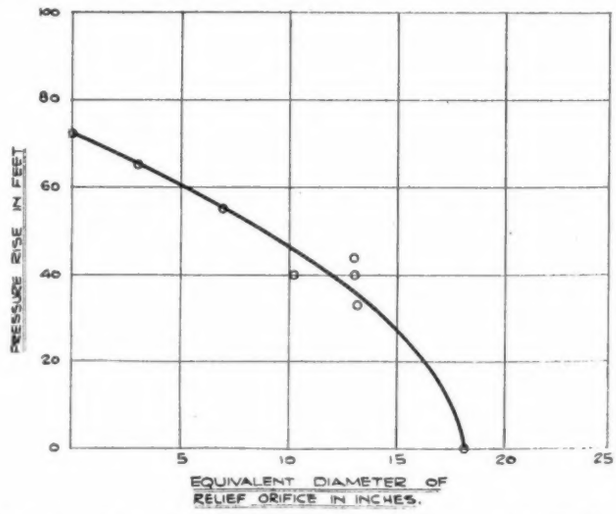


Fig. 4.—Curve Showing Reduction in Surge with Various Diameters of Relief Orifice Tested with a Single Pump Tripped Out

fied accordingly. The problem of the proper tripping and reclosing points was studied carefully, and the decision was made to set the opening points at intervals of approximately 5 pounds per square inch apart on the theory that the down-surge would be greater as additional pumping units were operated. This was found to be true but the differences were sufficiently small to require extremely accurate adjustment. It was determined from a careful investigation that the *duration* of this down-surge was the factor that varied most uni-

formly with the number of pumps in service; it being proportional to the time required for the retardation of the water column in the discharge line. Further, with a larger number of pumps operating the velocity was greater and, for a relatively constant rate of negative acceleration, the elapsed time for the column of water to come to rest was almost in direct proportion to the quantity flowing. The curve shown in Fig. 5 illustrates this relation very well.

By adjusting the tripping point as originally contemplated, and, also, providing a control on the *rate of opening,* it was possible to provide the correct performance in relief opening for each combination of pumps operating at one time and without the necessity of changing the settings on the surge suppressor controls. The advantage of this arrangement is at once apparent. The adjustment can be set and locked in position and the plant operators need have no cause to change or modify them in any way thereafter. A schedule for the routine testing of the controls was prepared; and, by the manipulation of two small pet cocks the settings could be checked periodically and a record entered in the station log sheet.

Functioning of the Surge Suppressors

It may be of interest to study the operating diagram of the surge suppressors and to follow the description of the equipment. In Fig. 6, the three operating conditions are shown, position *a* being the normal one with the surge suppressor closed. The valve is of the Larner-Johnson type, the plunger being held closed by conduit pressure in the central chamber supplied through the control line *D* and *E*. The diaphragm controlled blow-off valve *G* is held closed by the pressure passing through *D* and *H*. The diaphragm is supplied with pressure from the same line, with valves *L* and *K* provided for test purposes to check the pressure at which the blow-off opens and closes, which may be done by throttling valve *L* and opening and closing valve *K*.

When the pressure drops in the line due to the down-surge that invariably follows the failure of the power supply to a centrifugal pump, the diaphragm valve is released and the blow-off opens, thus, exhausting the central chamber faster than pressure can be maintained through the control orifice *E*. The pipe line pressure on the nose of the plunger forces it open and the valve then reaches the position *b* in Fig. 6. The rate of opening is controlled by the amount of stroke permitted on

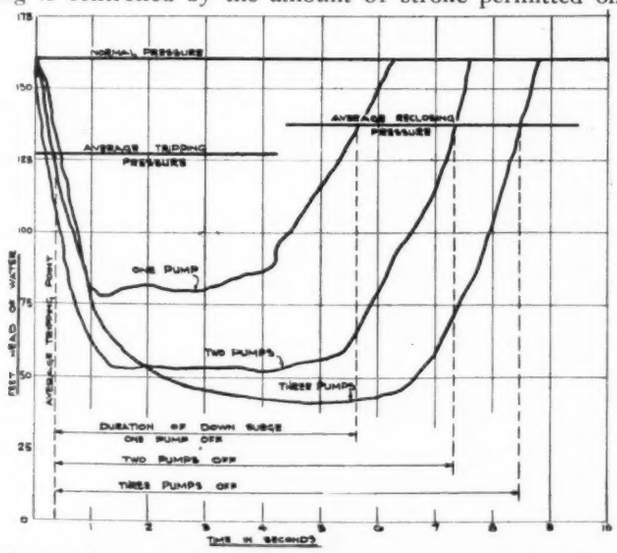


Fig. 5.—Curve Showing Variation in Amount and Duration of Down-Surge with Various Numbers of Pump Units Tripped Out Simultaneously

the blow-off valve. The point of tripping is controlled by the setting of the resisting spring on the diaphragm.

When the pressure builds up to a point higher than the tripping point the diaphragm valve recloses and the blow-off valve reseats, thus permitting the pressure to build up in the central chamber of the suppressor and the plunger starts closing at a rate that is controlled by the orifice *E*. The position *c*, in Fig. 6, shows the rela-

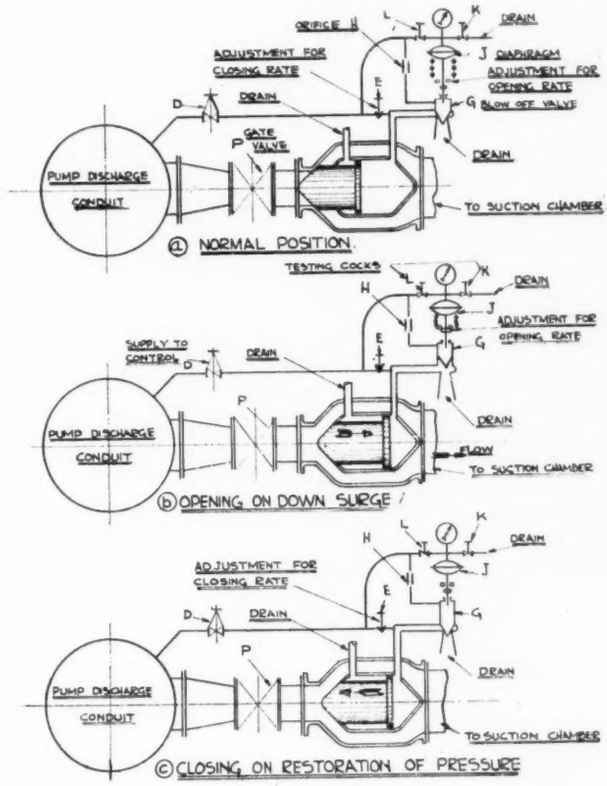


Fig. 6.—Diagramatic Arrangement of Surge-Suppressor Valve and Controls, in the Three Operating Positions: a, Normal Position Closed; b, Opening on Down-Surge; c, Closing Upon Restoration of Pressure

tion of the various elements. Where extremely slow rates are required, as is the case with very long pipe lines, the orifice *E* will consist of a series of stages or it may be necessary to employ external timing devices.

Limit switches are provided to indicate (on the main pump control switchboard) the position of the surge suppressors and, thus, informs the operator of their behavior.

A gate valve is usually provided between the conduit and the surge suppressor in order that the suppressor may be cut out during long shut-down periods, or to permit the inspection of the suppressor in accordance with the routine maintenance schedules. The surge suppressors can also be employed as drain valves merely by tripping the controls manually. They are also employed as by-passes in some cases, but this service is not recommended unless care is taken to have sufficient relief area available in case the power failed and the pumps shut down in an emergency.

The performance of the surge suppressors at the Croton Plant has been very satisfactory. The pressure rise has been reduced from dangerous proportions and has been held to a maximum of 5 pounds per square inch above normal for any emergency shut-down when one, two or three pumps tripped out simultaneously. Since this is less than ten per cent of the normal pressure, there has been no difficulty whatever experienced with water-hammer.

A NEW METHOD OF SLUDGE DRYING

By JOHN R. DOWNES

Superintendent, Joint Sewage Treatment Works, Plainfield, N. J.

John R. Downes

IN the search for a dependable method of sludge drying which will be independent of the vagaries of weather and climate, economical in operation and not too complicated, the Plainfield Joint Sewage Works has turned to Spray-Drying, a method in use for some time past in the drying of chemical and food products.

Spray-Drying is a system which takes advantage of the ease with which water may be evaporated when exposed to heated air in the form of a fine mist. The difficulties of atomizing the suspension to be dried, by forcing it through small nozzles under great pressure have been overcome in the system used by Industrial Associates, Inc., of New York City. Their system consists of "atomization" by means of centrifugal force. This atomization is accomplished by running the solution or suspension onto a small disk, which revolves at the rate of 10,000 r.p.m. The space about the spinning disk within a radius of 10 feet is filled with a dense fog of the atomized material thrown off from the disc.

The "Atomizer" is set at the center of a circular drying chamber and slightly below its ceiling. Close to the ceiling, and above the plain of the revolving disc, hot air is introduced through suitable ports. This air instantly gives up its heat in evaporating the fog and is drawn off through ducts properly spaced around the lower part of the drying chamber. The solid material thus deprived of its moisture falls to the floor of the drying chamber from which it is removed by a mechanical rake.

Application at Plainfield, N. J.

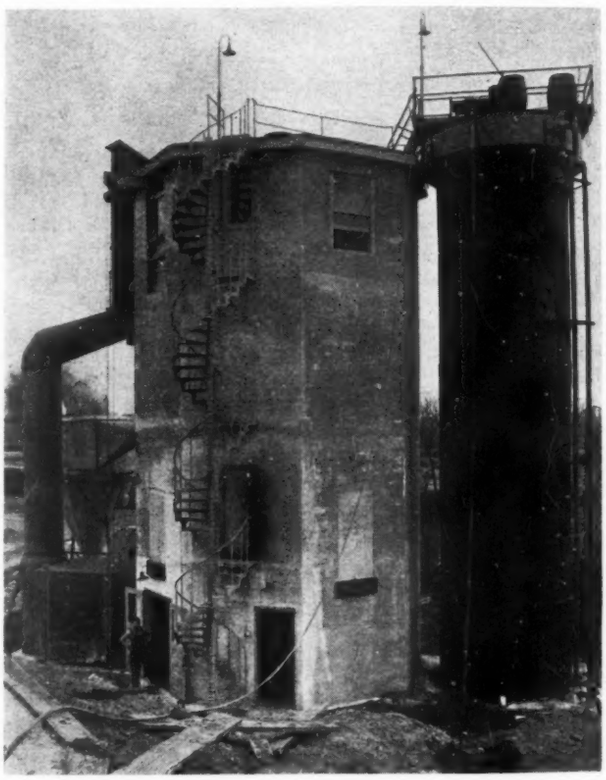
As applied at Plainfield, this system takes the following form:

The drying chamber occupies the middle portion of an octagonal tower 20 feet in diameter and 40 feet high.

Plainfield Sludge Beds and Sludge Lagoons, to Be Relegated to "the Land of the Obsolete" by the Hygienic Inoffensive Spray-Drying Method of Sludge Disposal.

The lower part of the tower is used to house the air heating furnace, a circulating fan and the product hopper and pneumatic conveyor. The portion of the concrete tower above the drying chamber constitutes the operating room. The operating room contains all control apparatus, a sludge pump for feeding the atomizer, a motor generator set to step the 60 cycle current up to 160 cycles in order to secure the necessary 10,000 r.p.m. at the atomizer, and a small air compressor used to actuate temperature controls.

The drying chamber, proper, is lined with sheet metal in the form of a true circle clearing the nearest portions

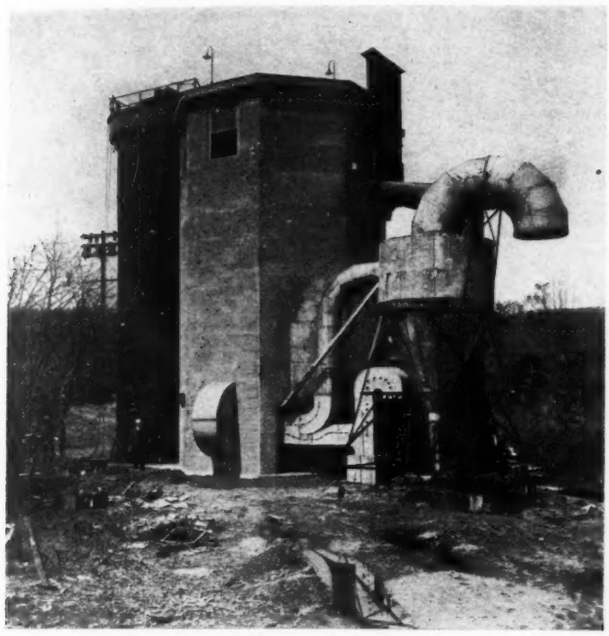


Spray Drying Equipment for Drying Sludge at Plainfield, N. J. Furnace and Hot Air Duct at Left; Drying Tower, Center; Flotation-Concentration Tank, Right.

of the enclosing concrete wall by 2 inches. Since the enclosing tower is octagonal, the space between the metal lining and the concrete varies from 2 inches to 12 inches. This space is completely filled with insulating material. There is also 2 inches of insulation between the metal ceiling of the drying chamber and the concrete floor of the operating room.

Source of Heat

The furnace, burning soft coal, is of brick and is fired from inside the base of the tower and extends through the wall of the structure. At the rear of the furnace and built integral therewith is an air mixing chamber from which the flue leads directly to the hot air inlet ports at the top of the drying chamber. An exhaust fan also housed in the furnace room and connected with the



Spray Drying Equipment for Drying Sludge at Plainfield, N. J. Concentration Tank in Background; Dust Collector, Right Foreground.

exhaust ducts of the drying chamber, draws the hot air, including the products of combustion, through the drying chamber and discharges into a cyclone dust collector.

The furnace is fired by means of an underfed automatic stoker, having a coal burning capacity of 400 pounds per hour. The exhaust fan has a capacity of 13,500 cfm. at 2 inches water pressure, rated with air at 200 deg. Farhenheit.

Automatic Control

The automatic stoker may be set to deliver air to the drying chamber at any temperature up to 900 degs. F. Triple interlocking automatic dampers at the junction of the furnace flue with the hot air inlets to the drying chamber and with the vent flue and a cold air emergency inlet port, control the temperature of the exhaust air from the drying chamber. The dampers are actuated by compressed air. Their purpose is to maintain the temperature of the exhaust air at any predetermined point around the boiling point of water, thus preventing scorching of the dried product. This control also governs the moisture content of the finished product.

Disposal of Product

The dried sludge falls to the floor of the drying chamber in a fluffy mass with the appearance of black mineral wool or the contents of a domestic vacuum cleaner bag. A rotating plow mechanism pushes the product into a hopper extending through the floor into the furnace room. From this hopper a pneumatic conveyor delivers the product either to the cyclone dust collector or to the furnace, where it burns as pulverized fuel. As fuel it supplies one-third of the heat required in the drying process and it will be so used unless the fertilizer market is such as to return a higher profit than the fuel value.

Flexibility

Any portion of the exhaust air may be returned to the air mixing chamber at the rear of the furnace in order to recover the residual heat. Any desired moisture content between 0 and 50 per cent may be maintained in the dried product by controlling the exhaust temperature. While the projected drying rate is ten gallons of 90 per cent moisture sludge per minute, it's possible to increase this rate by 50 per cent and the Marlow slow-speed pump, feeding the atomizer, is equipped with a variable Reeves Drive so that the rate can be increased or decreased by 50 per cent without interferring with continuous operation. The automatic stoker is equipped with variable speed control in addition to several adjustments of the coal feed.

Sludge Concentration by Flotation

Since doubling the per cent of solids in a sludge cuts the amount of water to be evaporated in half, it is obvious that in a system of this kind the density of the sludge to be dried is a very important factor. In order to insure as dense a sludge as possible we concentrate the digested sludge by a scheme of flotation. This is accomplished by treating the digested sludge with chemicals which not only coagulate it, but fill it with gas to give it buoyancy. Clear liquid is drawn off continuously at the bottom of the flotation tower and the thickened sludge is continuously removed from the surface and fed to the atomizer by means of a skimming rake. At Plainfield the flotation takes place in a tall steel tank adjacent to the drying tower and extending just above the latter. The thickened sludge is raked into an annular trough around the top of the flotation tank and thence goes to the suction of the Marlow pump which is provided to feed the atomizer positively and uniformly.

Limitations

The Plainfield installation is about as small as can be provided. This limitation is due to the amount of space required for proper atomization of sludge. This system of sludge drying is, therefore under present conditions, not adaptable to very small plants. The minimum cost of an installation will be about $30,000, but the smallest practical plant will accommodate up to 100,000 connected population if run 24 hours per day, which would be the most economical condition.

[Note: In a later issue Mr. Downes will publish operating data, results and costs of operating this novel plant for drying sewage sludges.—EDITOR.]

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G. L. Fugate Opens Engineering Offices in Houston, Tex.

G. L. Fugate, C.E. of Houston, Texas, has severed his connection with the City of Houston, which he had served as Principal Assistant City Engineer for 21 years. Henceforth he will practice engineering with offices at 629 Harvard Street, Houston.

The first large activated sludge plant was built and operated under his direction in Houston, where early concepts of the theory and practice of activated sludge processes were proved or disproved; and, many new ones were there developed. Under Mr. Fugate's direction (1918) the first carload of processed sludge was produced and sold at Houston for its fertilizer values.

Because of a specialized knowledge in sewage treatment and his "schooling by practice" in the activated sludge process, Mr. Fugate is in a position to offer his services to municipalities or associated engineering firms as an expert on design and operation—a knowledge of the latter making for highest efficiency in the former and vice versa.

In addition, Mr. Fugate will practice in other fields of municipal and drainage engineering.

INSERTING GATE VALVES IN WATER MAINS UNDER PRESSURE

By CHARLES STREITHOF

General Superintendent,
Department of Water Works, Evansville, Ind.

THE first Water Works of Evansville, Indiana, was built in 1873 and, like so many water plants that were built about that time, little thought was given to the sizes of pipe and proper number and location of valves installed in the system. Only a few valves were used, the distance being from 2,000 to 3,000 feet between valves on 10 to 12 inch lines. On smaller sizes the distance was 1,500 to 2,000 feet between valves.

Later (1895), when larger lines were laid, such as 20, 24, and 30 inch, the distance between valves on 20-inch lines was 1,500 feet, on 24-inch lines 2,600 feet, and on 30-inch lines 3,600 feet. After the present pumping station was placed in service in 1901, more attention was paid to the laying of water mains and the installation of valves.

In 1914 and 1915 a thorough survey of the 115 miles of pipe (4 to 30 inch), constituting the distribution system, was made. A close check was made on distance between valves, and the territory which would be affected should various valves have to be closed. A map was made of the distribution system on which was shown the different sizes of pipe and location of valves and fire hydrants, with or without valves. We then marked on the map with red ink the points at which additional valves should be placed so as to cut down the spacing and give the best service in any one district. We submitted our report and recommendations to the Water Works Trustees and were very glad to be granted about half of the amount of money we asked for.

Hazard of Shut-Down Avoided by Use of Valve Inserting Machines

We at first started out to shut down lines and install double hub valves. Sometimes at one shutdown two or three valves were put in but on account of the large territory being out of water, and the danger of fires, this method was abandoned. The Water Works Trustees agreed to appropriate enough money for purchasing a valve inserting machine for 4, 6, and 8-inch size valves, also to purchase a few larger size valves. This was done in the summer of 1917.

As the funds were running short during the war, and on account of the low water rate and high prices of material, the work of installing valves was discontinued. No additional valves were installed, except in new lines, until the summer of 1933. However, on all 6- and 8-inch pipe lines which have been laid since 1914, we placed valves at each street intersection—i.e., about 350 feet apart in each direction. On 12- and 16-inch mains the spacing has been 650 to 700 feet, with valves on all branch lines leading from larger mains.

During the summer of 1933 there were inserted two 30-inch, one 24-inch, two 20-inch, four 16-inch, five 12-inch, two 10-inch, five 8-inch, and fourteen 6-inch valves—all being installed with the mains under pressure. A contract for this work was placed with the A. P. Smith Mfg. Co. of East Orange, N. J., who furnished the valve inserting machines and one operator, for inserting the valves under pressure for sizes from 10 inch to 30 inch. The smaller machine had been purchased by the Water Department, and was operated by our own crew.

The average time for inserting 30-inch valves was about 16 working hours, and for 20- and 24-inch valves about 8 to 10 working hours. That, however, did not include time required for digging the holes or back filling. During the entire time there was no interference to the water service and the amount of water wasted did not exceed two or three barrels for the large sizes. On the 6- and 8-inch lines two and three valves per day were inserted with a crew of five men at the machine.

The average valve spacing in residential and manufacturing districts is now 550 feet, and in the congested district 700 to 900 feet, the latter being caused by the water mains being under the street car tracks where the inserting machine could not be very well used. Water mains outside of the city limits are provided with valves every 600 feet on 6-inch and 8-inch lines. However, on the 20- and 24-inch lines which run from the city to the reservoir on the North Side, the valves are installed only about every 2,500 to 3,000 feet.

Cost of Valving the System

The cost of labor and material for inserting valves in 1917 for two 20-inch, four 16-inch, three 8-inch and thirty-five 6-inch valves	$5,517.00
Labor, lead, yarn and valve boxes	1,603.85
Repair of streets	426.50
Total	$7,547.35

The cost of labor and material in 1933 was as follows:

35 valves 6 inch to 30 inch	$16,476.00
Material furnished by the Water Department such as: lead, yarn, man-hole covers, bricks and cement	459.72
Labor	2,233.88
Repair of streets	672.00
Total	$19,841.60

General Distribution Features

At the present time there is in the distribution system 214 miles of 4- to 30-inch mains. But there is not much 4-inch size in the system now because it has been replaced with larger pipe. There are 3,992 valves of various sizes (4 to 30 inch) and 1,467 fire hydrants with 6-inch branch and 6-inch control on each hydrant. There are 22,134 services (1 to 6 inch) and 21,637 meters (⅝ to 6 inch) and 96 automatic sprinklers on the system.

The 20 million gallon reservoir, located seven miles north from the Main Pumping Station, with an overflow elevation of 177 feet above the pump floor, is connected direct to the distribution system. It is able to supply the city with 50 pounds pressure should the pumps at the main station be shut down. Under today's condition the supply in the reservoir will furnish the city with water for a period of two to three days. The 20- and 24-inch lines run to the city from the reservoir over separate routes. The reservoir is equipped with an Esterline and Angus Water Level Recorder with the recording instrument located at the Main Pumping Station.

Two high service districts (one north and one west of the city) are supplied with water through booster stations, with a 100,000-gallon tank located in each district. There is connected to the two booster stations 10½ miles of 6- and 8-inch pipe and 39 fire hydrants. Each system is connected direct to the general distribution system, and is separated only by check valves.

(The above paper was read before the Indiana Section of the American Water Works Association Meeting, held in Lafayette, Indiana, April 11, 1934.)

RESULTS FROM THE USE OF "BLACK ALUM" AT THE TRENTON FILTRATION PLANT

By JOSEPH Y. REID

Superintendent of Filtration, Trenton, N. J.

Joseph Y. Reid

THE Trenton (N. J.) Filtration Plant consists of sixteen rapid sandfilters each being 24 by 27 feet, arranged in two rows of eight, and fed by two 2.2 M.G. settling basins. The plant is so arranged that we can use the two halves of the plant in parallel, or either half alone. Due to the fact that we have a separate dry feed machine for each basin, we can absolutely separate the two halves of the plant for operation as two distinct units. There is no provision for agitating or flocculating the water entering the basins. The dry feed machines discharge the coagulant (dissolved) to the basin at the inlet end and we depend on the turbulence of the incoming water to mix the chemicals with the water. The basins have one baffle at the inlet end which extends from the roof to within six feet of the bottom and one at the outlet end that extends from the floor to within five feet of the roof. Our raw water is taken from the Delaware River, consequently its turbidity, color, pH, alkalinity, etc., are subject to wide variation.

Last June (1933) we were troubled with a raw water which was low in turbidity (21 p.p.m.), highly colored and peculiar tasting. We used alum at the rate of 1.35 grains per gallon but were unable to remove the color to meet our normal standard for effluent and increased alum dosage did not remove any of the taste. Such a heavy alum dosage clogged our filters with floc so fast that the length of run was cut to an average of eight hours. Due to the lack of turbidity in the water, most of the floc was carried over to the filters.

"Black Alum" Tried

About that time we learned about "Black Alum," which is an alum containing activated carbon, and decided to try some. By that time the color had further increased. We fed 1.35 grains per gallon of the "Black Alum" and removed all of the color, practically all of the taste and increased our filter runs to eighteen hours.

In August we decided to further test this new coagulant so we split the plant in half, using regular alum at the rate of 1.75 g.p.g. on one side and "Black Alum" at the rate of 1.25 g.p.g. on the other side. These dosages were equal as far as color removal was concerned, but the "black alum" removed the taste. The floc from the regular alum was thin and feathery and light weight while the black floc was larger, better defined and much less of it passed the basins to the filter. Apparently the fine carbon particles acted as a foundation for the floc and built it up or otherwise affected its qualities so that it settled out in the basin.

Some Winter Experiences

Last winter when the river was frozen over and oxygen supply cut off, we were troubled with phenolic tastes in the water. At the start of the taste period we had no "Black Alum" on hand, so that the reservoir was filled with tasting water. As soon as we could get another car of "Black Alum" we started to use it and in a little over a week the water furnished to the consumers was taste free.

When the ice in the river broke up the turbidity rose to above 1,000 parts. Again we split the plant in half, using black and regular alum. Three grains of black would give the same results as four grains of regular. This water was also contaminated with a musty taste and the carbon in the "Black Alum" was not sufficient to completely remove it, but there was a noticeable difference between the two effluents. In this case there wasn't any difference in the appearance or amount of floc carried over to the filters. Apparently the dirt load formed the foundation for the floc of the regular alum.

The Trenton Filters; Among the Early American Rapid Sand Plants, Later Renovated and Added to, Can Be Operated as Two Distinct Plants.

We are still using "Black Alum" and the color of our delivered water is less than it has ever been for the same length of time when using regular alum. Below is a table showing the difference in the delivered water, when the plant is split in half so as to utilize the two coagulants in parallel.

	Raw Water	"Black Alum"	Ordinary Alum
Turb.	10	0	0
Color	25	3	8
Alum Dose	1 G.P.G.		

In using "Black Alum" we found that it took a few days for the basins and filters to get impregnated with the small carbon content before the effect of the carbon was felt. The improved coagulation, color removal and lengthened filter runs, however, could be observed in a very short time.

Acknowledgement.—The Pennsylvania Salt Manufacturing Company of Philadelphia first called our attention to "Black Alum" and our supply has come from this company which we understand to be manufacturing the product under license granted by the Activated Alum Corporation of New York City.

ADAPTING THE "ELECTRIC EYE" TO THE CONTROL OF SEWAGE TREATMENT PLANTS

By FLOYD A. HOFFMAN

Superintendent of Water Works and Sewerage, Morristown, N. J.

ONE does not usually associate a scientific device such as a photo-electric cell or electric eye with the operation of a Sewage Treatment Plant.

Floyd A. Hoffman

However, I will try to show that not only can photo-cells be used to control certain processes in treatment plants, but results can be obtained by their aid which cannot be had in any other way.

For instance, it is impossible for the activated sludge plant operator to know just where he sludge blanket is in his final settling tank unless frequent measurements are taken or unless the sludge is near the "bulking" point. Then it is too late to prevent the flock from passing over into the effluent. With photo-cell control, the operator can predetermine the depth of clear liquid which it is advisable to maintain in the tank and he can set his photo-cell at that depth and forget it.

When the sludge blanket rises above the photo-cell, the pump or air lift will go into operation and remove the sludge until the cell is again surrounded by clear liquid, when the pumping operation will cease, until the sludge rises again. (See Fig. 1.) A time delay element may be incorporated in the control to prevent operation until a period of 20 to 40 seconds elapses after the cell operates. This will prevent momentary operation should a small quantity of flock pass between the cell and the light.

The depth of clear liquid in the final tanks can be read from small meters which may be located in the office at any distance from the tanks.

The writer, in an endeavor to operate the Morristown Activated Sludge Plant by pressing a button from a swivel chair, experimented for some time to develop an automatic device which would maintain the sludge at the proper height and prevent flock passing over the weirs with the effluent. In December, 1932, the apparatus described above was installed at Morristown and has been in continuous operation in the two final clarification tanks since. (See Fig. 2.)

The only troubles encountered in the 16 months of operation were that the first photo-cells used were not water tight, but we now have procured cells that are waterproof. The last cells installed, having been in service 10 months, and are still in operation. The life of the photo-cell is undetermined but they probably will operate several years. The only other cause of failure has been the burning out of the submerged electric light bulbs, but this also has been overcome.

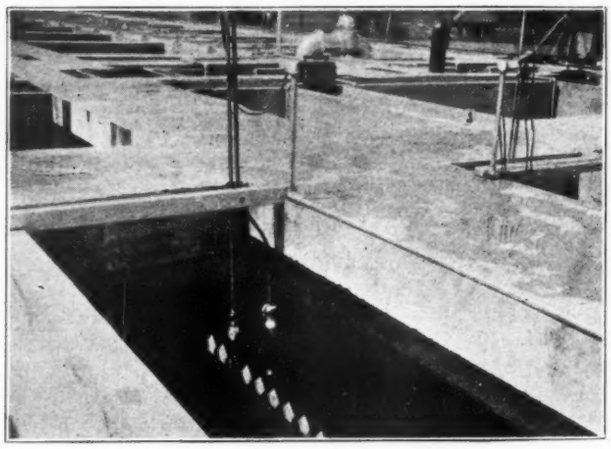

Fig. 2—The Cell and Light Bulb as Installed in Two Final Settling Tanks. The Unit Has Been Raised for Photographing. In the Tank to the Right It Is in Operating Position.

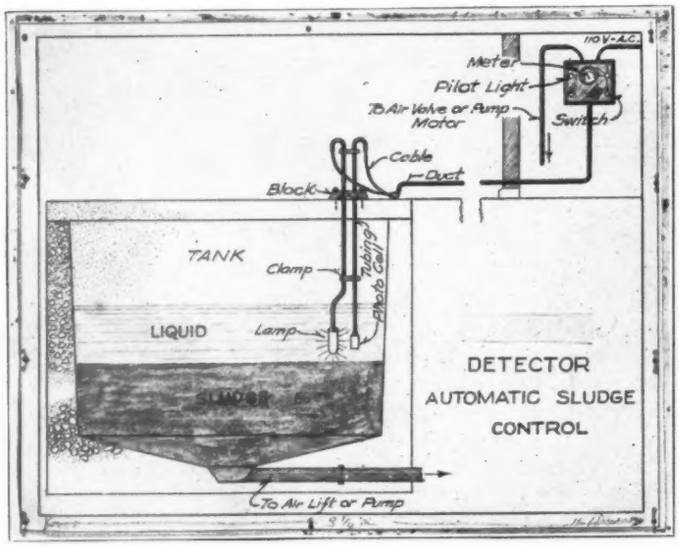

Fig. 1—Sketch of Arrangement Sludge Depth Detector and Automatic Sludge Transfer Control Equipment, Morristown Sewage Treatment Works, Morristown, N. J.

The control device as finally set up consists of three (3) units: 1st. The tank unit which consists of a source of light rigidly supported at a fixed distance from a special photo-electric cell. This unit is so supported as to be adjustable as to the depth of submersion in the tank and so indicated in Fig. 2.

2nd. A sensitive meter is furnished to measure the current produced by the photo-cell. The current flow serves to indicate the clarity of the liquid in the tank near the cell, thus giving an indication of whether the liquid is clear. If not clear, the approximate degree of turbidity is indicated.

3rd. A control panel containing a transformer, relays, a time delay element and a 10 amp. mercury switch, which has sufficient capacity to control any pump starter or any other device which it may be desired to operate.

The entire apparatus is operated from the electric light current. No batteries, amplifiers or other delicate devices are required.

Considerable difficulty has been caused at the Morris-

town Plant due to the light flock. The capacity of the final tanks (ability to function more effectively) has been materially increased due to the fact that the heavier sludge is being removed, under automatic control, in a scientific manner—not too much, not too little.

Before making the installation, our air lifts (Fig. 3) were often operated at a high rate and removed too much light sludge from the tanks. This resulted in overloading the plant by the return of an excessive volume of sludge to the aeration units. There are two air lifts on each tank. One is automatically controlled by the electric eye, the other is manually operated. The latter is set at a fixed rate to take care of the minimum sludge re-

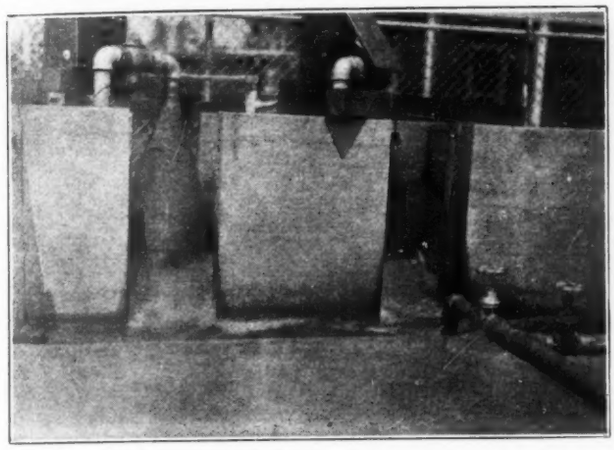

Fig. 3—Discharge of Air Lifts on Final Settling Tanks. One Is Set at a Constant Rate and the Other Controlled by the Automatic Device Varied to Meet Operating Conditions.

turn requirement and left alone. The photo-cell control takes care of all variations required in sludge removal as the load builds up. The feature is that it does not overdo the job.

Since the photo-cell control has been in operation the sludge blanket has been maintained at a constant level, except at times when the flow through the plant is far beyond the capacity of the tanks.

There appear to be other uses for the electric eye around the plant; for instance, to indicate or record the degree of clarity of the effluent and to notify the operator should the turbidity increase. And the percentage of solids in the returned and excess sludge may be read from properly calibrated meters and the necessary adjustments may be made automatically or manually.

It is also possible to arrange the photo-cell and light unit to rise and fall with the sludge blanket, thus obtaining a method of securing a variable speed control for pumps or other devices.

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P.W.A. Projects Moving

At the close of business on May 15th, checks totalling $109,131,000 had been mailed out to cover requisitions for funds by recipients of non-Federal allotments of PWA funds. Of this about $60,000,000 has gone for municipal, county and state projects.

PWA advises that obstructions have been cleared away on nearly all of the 2,400 non-Federal allotments and the $763,625,000 called for by loans and grants will be forthcoming in increasing volume to speed up construction and employment.

The administration has been accused of retarding progress, by its slowness to release money to municipalities, and it will be a relief to many to know that the ball is at last rolling.

It is of interest to note the increasing number of municipalities that, being impatient and having procured loans in the private investment market, have recently requested the cancellation of their loan allotment but are benefiting by the 30 per cent grant to which entitled. The loan money so released is available for additional projects.

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Water Works Code Up for Discussion

The Committee on a Code for the Water Supply Industry of the American Water Works Association is arranging for a conference to be held on the subject at the Hotel Commodore, New York City, the forenoon of June 4th, which is the opening day of the convention.

The committee has sent out an invitation to the mayors of 1,000 cities having municipally owned water works, and also to Association members in these same cities, to attend this conference with the idea of perfecting a Water Supply Code which will fit municipally operated systems as well as privately operated ones.

It would indeed be ideal if the entire water works industry could be operated under some form of code which would insure reasonable hours, fair pay, and reasonable security of position to every water works employe. It is our hope that something will come out of the conference which will be of value in that direction.

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Fined for Using Water for His Goldfish Bowl

An A. P. dispatch from Bristol, England, under date of March 16, states that a resident of Bristol was fined ten shillings by a magistrate on the charge he used water for his goldfish bowl during the recent water shortage. The accused admitted the charge, but declared that he reduced his own baths during the period, taking only two baths a week instead of the usual four, so that his prized fish could have fresh water. Although he listened sympathetically to the story, the magistrate nevertheless ordered the fine paid.

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Oil and Gasoline Separators to Be Standardized

On March 20, 1934, a committee was organized in New York for the purpose of establishing an American Standard for oil and gasoline separators to be installed in the drains of garages and other buildings to prevent flammable or explosive materials from entering municipal sewers. Those attending the meeting represented the manufacturers of these devices, the users, and municipal bureaus. The committee is sponsored by the American Society of Sanitary Engineers and the American Society of Mechanical Engineers.

Joseph J. Grotty, President of the American Society of Sanitary Engineering, presided at this first meeting and was elected permanent chairman of the new Subcommittee of the Sectional Committee on Standardization of Plumbing Equipment, and Mr. Gerhard Wagner was selected as its secretary.

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City May Provide Water for Indigent.—The City of Toledo, Ohio, will prepare legislation seeking to provide protection and assistance to property owners, who have indigent families living in their houses, in regard to payment of water bills. A solution will be sought through an ordinance by which property owners may pay current water bills and delinquent water bill payment will be deferred. It also will attempt to make provision that the person who uses the water will be obliged to place a cash deposit or guarantee before the city will extend water service.

PRACTICAL HYDRAULICS

II. The End Contractions of a Weir

By P. S. WILSON

Consulting Engineer,
Glen Ridge, N. J.

This is the second of a series of articles being presented by the author on selected phases of hydraulics from the viewpoint of the practical water-works operator.

Mr. Wilson's experience as Superintendent of Water Works and later as Superintendent of Operations of all Community Water Service Co. plants, enables him to contribute material of practical value.

His next article will deal with the value of making pressure-discharge tests on fire-hydrants and simplified methods of making such tests.—Editor.

A PREVIOUS article, which appeared in WATER WORKS AND SEWERAGE for April, 1934, discussed the measurement of water by means of a rectangular weir with a *sharp crest.* No mention was made of the correct design for the vertical ends of the weir notch.

There are two methods of constructing the ends of the weir. The first of these is shown in Fig. 1 and results in what is known as a weir *with end contractions.* In this design the sharp crest of the weir as formed by the bottom of the notch is continued up the ends of the notch, thus forming sharp edged ends for the weir. The water in flowing around these sharp corners then follows a course very similar to that taken in flowing over the edge of a sharp crest. In flowing around the edge from behind the weir it cannot change direction sharply and it curves inward toward the center of the weir contracting the stream as shown in the illustration.

The other method of designing the ends of the notch is to build it so that it extends the full width of the stream at that point, allowing the sides of the channel to form the ends of the notch and continue upstream at that width for a short distance, at least. An example of this method of construction is shown in Fig. 2. When so built it is known as a weir *without end contractions* because the water in this case flows straight over the crest, the stream continuing full width all the way. The weir thus consists of a simple dam or bulkhead across the channel.

It may readily be seen that if two rectangular sharp crest weirs have the same length and are flowing under the same head, the one that has end contractions (Fig. 1) is not discharging as much water as the weir without end contractions (Fig. 2). It has been found by experimentation that with sharp edged ends and a wide channel above the weir, so that the over-falling stream is fully contracted, the effect on the discharge of the weir is the same as if the length of the weir were reduced by a distance equal to one-tenth (0.1) of the head at each end of the weir.

For example: A sharp crested, rectangular, vertical weir is three feet long and the ends are so constructed that the flow will be fully contracted. If the head is one foot, then the effective length of the weir is reduced by one-tenth of a foot at each end making its effective length (3.0 — 0.z) = 2.8 feet—a reduction in capacity of about 7 per cent from the capacity it would have had without end contractions. Failure to make this correction might constitute a rather serious error.

If the head on the same 3 foot weir were only 0.1 foot instead of 1.0 foot (or if the length of the weir were increased to 30 feet with a head of 1.0 feet) then in either case the reduction in effective length would be only about 0.7 per cent which would be a negligible error except in the most precise measurements.

It is thus seen that the importance of making the correction for end contractions depends upon the relative head and the length of the weir. If the head is more than one twentieth (5 per cent) of the length then end contractions will require a correction of more than 1 per cent and should certainly be accounted for.

Weirs are seldom operated in practice under a head sufficiently great in proportion to the length that the correction for end contractions is of importance. In such cases it is evident that it does not matter how the ends of the weir are built. Many weirs under practical conditions are built so that they do not have theoretically sharp edged ends and yet neither are they ended against the sides of the stream channel. The ends may merely be formed by the wood or masonry of which the dam bulkhead is built. In such cases we know that there is some end contrac-

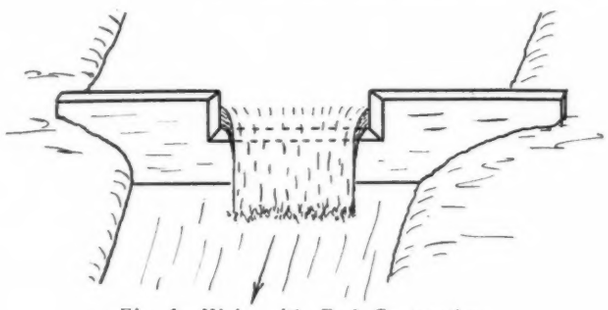

Fig. 1—Weir with End Contractions

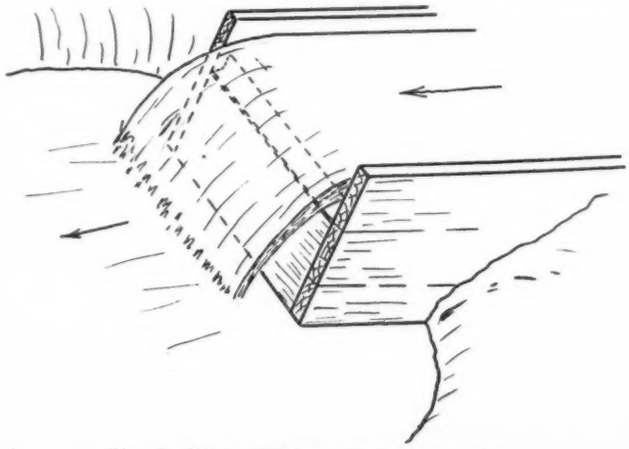

Fig. 2—Weir Without End Contractions

tion but we do not know how much. Such a weir should be checked up to determine whether the end contraction correction would be of importance if it were complete. If it is found that the relation between the maximum head and the length of the weir is such that the correction would not be of importance (less than 1 per cent), then we know that it does not matter what it actually is and it can be neglected. If it is found that the end contraction correction is of importance then either it must be estimated or else actual measurements of the flow must be made to determine what the correction actually should be. Usually it can be estimated. It is a help in estimating to actually observe the form of the stream during discharge of the weir.

If the relation between the length of the weir and the head is to be such that the end contraction correction will be of importance then the weir should, if possible, be built either with full contractions or with none at all so that the correction will be definitely known.

A weir may be built with a sharp edge on one end only so that the end has a full contraction and so that the other end has no contraction. The correction in such a case is, of course, only one-tenth of the head to be subtracted from the weir length.

A subsequent article will include practical details as to the correct method of measuring the head on a weir.

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The Water Supply of London

The following summary of the annual report of the Metropolitan Water Board of London, England, is taken from the February-March Official Circular of the British Water Works Association:

The total estimated population supplied by the Board at March 31, 1933, exclusive of bulk supplies, was 7,211,376, representing an increase of 90,303 during the year, or the equivalent of a town the size of Ipswich. Of this increase, 38,678 occurred in the area north of the Thames and 51,625 south of the Thames. Of the total, 4,563,587, or 63 per cent, reside in the area north of the Thames and 2,647,789, or 37 per cent, south of that river.

During the month of maximum supply (June) the Board supplied a daily average of 302.88 million gallons. The daily average supply per head was 39.25 gallons, being an increase of 0.10 gallon compared with the year 1931-32.

The quantity of water supplied was 103,263.0 million gallons, with a daily average of 282.91 million gallons. The total daily average supply was 2.14 million gallons more than in the preceding year. During the month of maximum supply (June) the Board supplied a daily average of 302.88 million gallons. The daily average supply per head was 39.25 gallons, being an increase of 0.10 gallons compared with the year 1931-32.

The number of services was 1,329,783 at March 31 last, an increase of 21,133 during the year. The amount of storage and subsidence reservoir capacity for unfiltered water possessed by the Board at the end of the year was 2,704.5 acres, with a capacity of 19,657.0 million gallons. According to the supply of 1932-33 the number of day's storage is 69.5 for the grand total supply (including bulk supplies).

The amount of storage and subsidence reservoir capacity for unfiltered water possessed by the Board at the end of the year was as follows:

	No.	Area in acres	Capacity in million gallons
Thames Valley	32	1,749.5	14,017.5
Lee Valley	17	955.0	5,639.5
	49	2,704.5	19,657.0

According to the supply of 1932-33, the number of days' storage is 69.5 for the grand total supply (including bulk supplies).

Owing mainly to the superior efficiency of new machinery which has been installed, a large reduction in coal consumption has taken place, and it is confidently anticipated that the bringing into operation of the new stations at Deptford, Surbiton and Brixton will result in an additional savings of 14,000 tons of coal per annum.

The net water rental of the Metropolitan Water Board during 1932-33 was £4,943,193, according to the annual report just issued. The percentage of collection in respect of domestic supplies and fixed charges was 95.80, the amount collected having been £3,573,121.

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Association Meetings Scheduled

June 4-8—Annual Convention of American Water Works Association. Hotel Commodore, New York City. Secretary, B. C. Little, 29 W. 39th St., New York City.

June 5-6—**Arizona Public Health Association.** Prescott, Ariz. Secretary, Jane H. Rider, Director State Laboratories, Tucson, Ariz.

June 13-14—**Illinois Association Sanitary Districts,** Waukegan, Ill. Secretary-Treasurer, G. H. Radebaugh, Urbana, Ill.

June 15-16—**New York State Sewage Works Association.** Jamestown, N. Y. Secretary, A. S. Bedell, State Department of Health, Albany, N. Y.

June 25-27—**Pennsylvania Water Works Operators' Association.** State College, Pa. I. M. Glace, Secretary, State Department of Health, Harrisburg, Pa.

June 28-29—**Pennsylvania Sewage Works Association.** State College, Pa. L. D. Matter, Secretary, State Department of Health, Wilkes-Barre, Pa.

July 12-14—**Virginia Section, A. W. W. A.** Martinsville, Va. Secretary, H. W. Snidow. State Department of Health, 601 State Office Building, Richmond, Va.

Aug. 22—**West Virginia Conference on Water Purification.** Hotel Windsor, Wheeling, W. Va. Secretary, J. B. Harrington, State Department of Health, Charleston, W. Va.

Aug. 23-24—**Central States Section, A. W. W. A.** Hotel Windsor, Wheeling, W. Va. Secretary, H. L. Nelson, U. S. Pipe and Foundry Co., 2435 Koppers Bldg., Pittsburgh, Pa.

Sept. 3-6—**Annual Meeting of American Public Health Association.** Pasadena, Calif. Willimina R. Walsh, Secretary, 450 7th Ave., New York City.

Sept. 17-19—**Rocky Mountain Section, A. W. W. A.** Santa Fe, N. M. Secretary, B. V. Howe, Board of Health, Denver, Colo.

Oct.—**California Section, A. W. W. A.** Long Beach, Calif. Secretary, J. E. Phillips, Department Water Supply, 207 Broadway, Los Angeles, Calif. (Exact date later.)

Oct. 15-18—**Southwest Water Works Association.** Hotel Hilton, Waco, Texas. Secretary, Lewis A. Quizley, Superintendent Water Department, Fort Worth, Texas.

Nov.—**North Carolina Section, A. W. W. A.** Virginia Dare Hotel, Elizabeth City, N. C. Secretary, H. G. Baity, Dean of Engineering, University of North Carolina, Chapel Hill, N. C.

Nov. 8-10—**Missouri Valley Section, A. W. W. A.** Hotel Fontenelle, Omaha, Neb. Secretary, Prof. E. L. Waterman, University of Iowa, Iowa City, Ia.

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Dorr-Oliver Corporation Being Dissolved

After affiliation for three years, it has been agreed to dissolve the Dorr-Oliver Corporation, and that the Dorr Company, Inc., and Oliver United Filters, Inc., thereafter will operate independently of each other.

The separation of the two companies has been brought about on an entirely friendly basis and a close cooperation and joint agency arrangements will be continued.

WRECKING ELEVATED WATER TANKS

By CARL A. HECHMER

*Department Engineer**
Washington Suburban Sanitary District, Hyattsville, Md.

Carl A. Hechmer

MUCH has appeared in water works literature dealing with the design, erection and maintenance of water tanks and towers. But, little has been said concerning the most economical or practical means of removing such tanks after they have become inadequate or obsolete and the Water Department finds a valuable asset has become a liability. Sometimes a tank can be taken down and re-erected at another location, but the cost of such work is high and more often it is more economical to erect a new tank. In this article two methods of wrecking tanks are explained, different methods being necessary because of the nature of the surrounding properties.

The Washington Suburban Sanitary District found itself confronted with the problem of disposing of three water tanks. No sale could be found for these tanks since they were old and the cost of taking them down and re-erecting was prohibitive. They were too small to be of further value in the Sanitary District's water system, the land upon which they stood had increased materially in value, and the residential developments in the vicinity made the tanks objectionable blots on the landscape.

The three tanks were located in Hyattsville, Kensington and Chevy Chase, the sizes and heights being shown in Table I. These tanks were used on the individual small water systems which existed before the creation of the Washington Suburban Sanitary District and were taken out of service when the several existing systems were incorporated into the general water system built to serve the entire district.

The Chevy Chase tank was the first tank dismantled, and later the Kensington tank, the same method of wrecking being employed in each case. The lowest bid received for taking these two tanks down piece by piece, hauling away and disposing of the steel was $990.00. Under the method explained below, the total cost of wrecking the tanks and disposing of the steel was $150, a saving of $840. Since there were no houses or other structures in the way, it was decided to throw the tanks over and cut up the steel on the ground, eliminating the necessity of employing trained climbers and special steel cutting equipment. The speed of cutting on the ground was much greater than in the air, resulting in a saving of labor and gas. The time factor also entered into the problem, the Commission having agreed to have the Chevy Chase tank removed from the site within a specified time.

Method of Throwing the Tanks

The method employed in throwing these tanks from their foundations is shown in the accompanying sketches.

*Mr. Hechmer has the distinction of being the chairman of Plant Management and Operation Division of the American Water Works Association.—Ed.

Hyattsville Tank. Standpipe First Removed, Then Most of Bottom, Through Which Plates Were Dropped to Ground as Cut. Location Indicates Why Falling Would Have Been Dangerous Practice.

Having decided in which of four directions the tank could be thrown, using two legs as an axis, a section approximately eight feet long was cut out of leg "A." The height of the section removed governs the length of jump of the tower legs from their foundations on the axis "B-B." The foundation bolts on the remaining three legs were then cut. A timber 6 x 6 inches was placed through the cross members of leg "C" and two ten-ton screw jacks placed as shown, supported on wide planks. The jacks were operated together, slowly raising the leg "C" from its foundation. Steel plates were inserted under leg "C" with each one-inch rise of the jacks. This precaution served as a safeguard to prevent the tank from swaying and falling in the wrong direc-

TABLE I

Tanks Location	Capacity Gals.	Dimensions in feet* A.	B.	C.
Hyattsville	100,000	27.2	75.3	22
Chevy Chas.....	37,300	16.4	77.1	17
Kensington	60,000	21.3	108.9	19

*See Figs. 1 and 2.

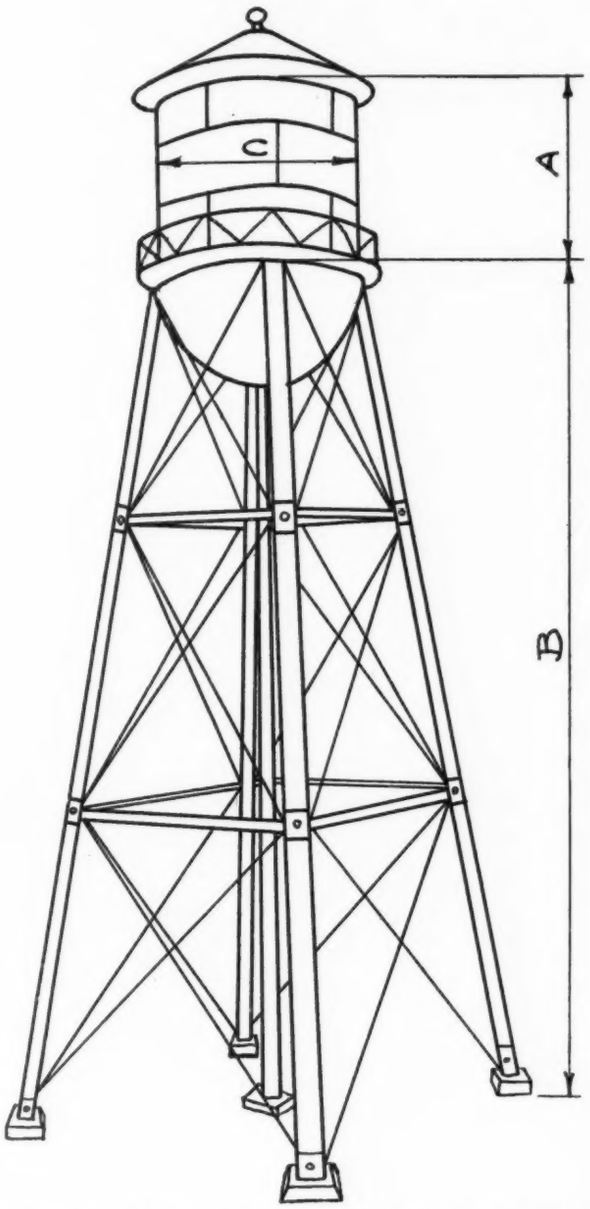


Fig. 2.—The Hyattsville Tank Which Was Taken Down by Cutting Plates (Washington Suburban Sanitary District).

tion should the jacks slip and the lack of support on leg "A" cause leg "C" to fail. A total lift of 12 inches by the jacks was sufficient to throw the tank over. The work of throwing the tanks required only one hour

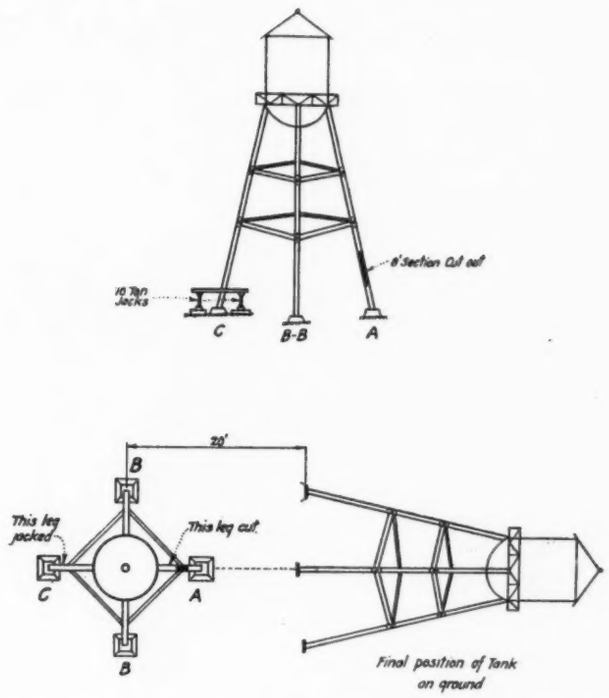


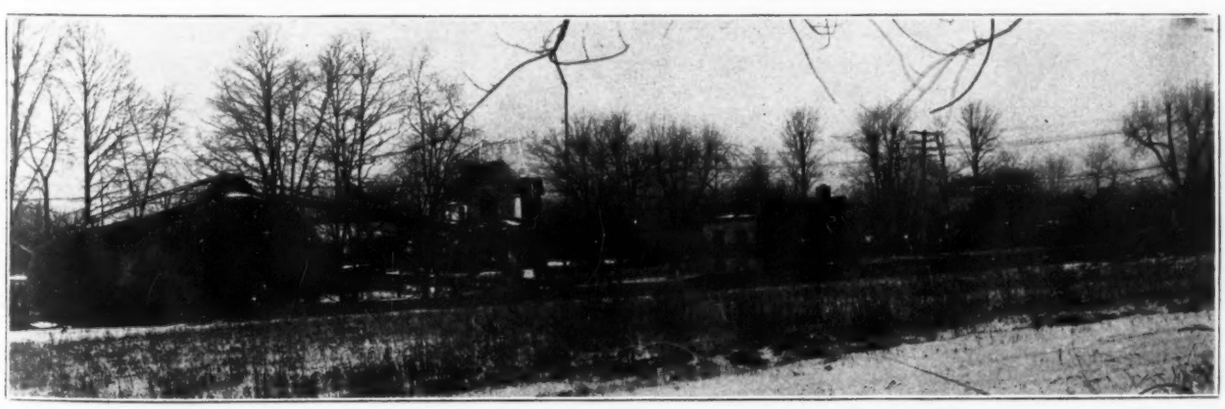
Fig. 1.—Method Employed in Throwing the Chevy Chase and Kensington Tanks (Washington Suburban Sanitary District).

each, and the steel cutting on the ground and trucking away for junk required only a few days.

The Hyattsville tank could not be thrown down in this manner because houses were built on the three adjoining lots, the fourth side being a public street. In this case it was necessary to cut the tank in the air dropping each piece separately to the ground and later cutting the steel in sizes for sale as junk.

The riser pipe was first removed and then a hole was cut in the bottom of the bowl, large enough to allow the passage of the plates as they were cut. The roof and side plates were cut in sections and dropped inward, the bowl acting as a funnel or guide, all the steel falling within the area covered by the four legs. This method also proved very satisfactory as well as economical, the total cost being $125, including cost of insurance against damage to adjoining properties.

All of the work was carried out without accident or mishaps. The Commission was confronted with a total expenditure of approximately $1,500 to dispose of these tanks, but with the methods employed as explained the total cost was only $275.



Kensington Tank After the Fall

FRICTION COEFFICIENT OF CAST IRON SEWER AFTER 30 YEARS' SERVICE

By ALEXANDER POTTER
Consulting Engineer, New York City

DURING the past year tests have been conducted on a cast iron sewer forming a portion of the intercepting sewer system serving twelve municipalities in the Elizabeth and Rahway River Valleys in Union and Essex Counties, New Jersey. The section chosen for the tests is on a uniform slope, with no bends, manholes, or increments of flow in the entire length between observation stations. Accordingly, the friction coefficient values were fixed solely by the condition of the pipe interior.

Alexander Potter

The pipe was laid under the supervision of the writer in 1903 and was dipped according to specifications for the old-fashioned "Angus Smith" coating.

The reduction in capacity of the line after thirty years' service is estimated to be 20 per cent, based on the assumption that the Williams-Hazen coefficient of the line when installed, was 120.

Description of Test Line

The section under test is 36 inches in diameter, 1,497 ft. in length between upstream and downstream manholes where observations were taken, with a uniform grade of 0.121 per cent. The entire line is laid above ground on piers through swampy land (see plate 1), thereby making it possible to obtain a profile along the top of the pipe, which revealed a maximum deflection from grade of but 2 inches.

Difficulties frequently encountered, due to flow from branches or infiltration, or due to disturbance of flow in manholes, bends, or changes in gradient, were entirely absent in the test section.

Condition of Pipe Interior

The condition of the pipe interior is illustrated by Figs. 1 and 2. The portion of the pipe below the minimum flow line was found to be relatively smooth with little or no corrosion. The portion between the minimum flow line and the level of the average daily maximum flow, representing a vertical height of 13 in. was heavily coated with a slimy crust ¾ in. in thickness, which is visible in the photographs. Heavy corrosion with pitting to a depth of ¼ in. was observed under this slime. The remaining portion of the perimeter, above the level of the average daily maximum flow, showed substantial corrosion, but was free from slime.

Test Methods

The slope was determined by measuring with a rod to the water surface, from reference elevations established across the top of the observation manholes by levels run and checked between the two observation stations. Computations of hydraulic radius, areas, and coefficients were based upon the average hydraulic properties at the upstream and downstream stations.

Velocities used as a basis for the reported coefficients, were obtained by the color method of velocity measurement. The time of travel selected as indicating the *mean* velocity, was the interval between the time the color was dumped, and the mean time of appearance at the downstream observation station. Velocities were checked, however, by several alernative methods discussed in the following paragraph.

Alternate Methods of Velocity Determination

Several methods of velocity determination were made to verify the adoption of the mean time of appearance, (or in other words the time of travel to first color appearance plus one-half the time interval between first appearance and disappearance in the downstream manhole) as representing the *mean velocity*.

The results indicate that for approximate velocity tests, where facilities do not permit use of the color method, reasonably accurate results can be obtained by deducting 10 per cent from the velocity obtained with a bottle float and thus obtain the *mean* velocity.

Test Results

A preliminary test was run on June 6th with the results shown in Table II. In these tests there was a substantial difference between the depth of flow at the two ends of the test section, due to a drop-down condition at the downstream end which was created by an adjacent section of 38 in. brick sewer on a steeper grade. These preliminary tests are reported only to indicate that reasonably accurate results are possible even when conditions of non-uniform flow exist.

A second series of tests were conducted on June 16th, with the drop-down eliminated by throttling the

Because of the increasing interest shown in the use of light weight cast iron pipe in sewer construction, the question as to the added value of smooth protective linings seemed to be one of some importance.

With the thought in mind of evaluating the permanency of cast iron as a material for sewer construction, its resistance to corrosion by sewage and the sustained carrying capacity of cast iron sewers, Mr. Potter has at the instance of a request from WATER WORKS AND SEWERAGE made the necessary investigation, the findings of which are reported in this article.

After 30 years of continuous service a 36-inch sewer of cast iron, carrying mixed industrial and domestic sewage, shows a loss of but 20 per cent in its original carrying capacity, the following friction coefficient values being observed: Kuttens "n"—0.015; Chezy's "C"—93.4; Williams-Hazen's "C"—96.0.

Had smooth protective linings been available at the time of construction the author predicts that the carrying capacity would have been 55 per cent greater than the 80 per cent of the original now observed.—Editor.

Plate 1.—One of Sewers, Laid 31 Years Ago to Service 12 Municipalities in Union and Essex Counties, New Jersey. The Photograph Was Taken Shortly After Completion of the Sewers.

Fig. 1.—Interior of 36-in. Cast Iron Sewer After 30 Years of Service. Some Corrosion Observed Above the Flow Line. Below the Minimum Flow Line There Was None. (See Remarks Under Fig. 2 Also.)

flow at a manhole several hundred feet downstream from the downstream observation manhole. The back water was so controlled as to create substantially a uniform flow and equal depths at both ends of the test section.

The results of this second series of tests are shown in Table III. Comparison of Tables II and III shows that the artificial elimination of the drop-down condition, produced more consistent results.

Change in Friction Coefficient and Capacity Reduction During 30 Years' Service

In the following tabulation is shown the friction coefficients and capacities of the line under various conditions, first: when new, based on an assumed value of the Williams-Hazen coefficient of 120; second, at the present time after thirty years' service; and third, for

TABLE I.—ALTERNATE VELOCITY MEASUREMENTS.

Description of Method	Velocity Ft./Sec.	Ratio to Mean Velocity
a) Wooden surface float indicating maximum surface velocity	3.29	112%
b) Bottle submerged 4 in., representing essentially the surface velocity	3.19	108.5%
c) Time interval to first appearance of color	3.10	105.5%
d) Mean time of color appearance	2.94	100.0%
e) Time interval to disappearance of color	2.79	95.0%

TABLE II.—PRELIMINARY TEST TO DETERMINE FRICTION COEFFICIENT

30 Year Old Cast Iron Sewer

(With Unequal Depths of Flow at Upstream and Downstream Gaging Stations)

(Length 1,497 Feet) (Slope of Invert 0.121%)

	Velocity based on *mean* time of appearance of color (ft./sec.)	Depth of Flow—At Upstream M.H. (feet)	Depth of Flow—At Downstream M.H. (feet)	Average depth (feet)	Hydraulic Radius	Slope per foot	Friction Coefficients—Chezy "C"	Kutter's "n"	W.-Hazen "C"
1	3.12	1.62	1.02	1.32	.688	.00161	93.5	.0148	96.
2	3.52	1.97	1.27	1.62	.785	.00168	97.0	.0146	98.
3	3.41	1.96	1.20	1.58	.776	.00172	93.6	.0150	95.
4	2.26	1.01	.56	.79	.455	.00151	86.0	.0146	93.5
5	2.40	1.12	.63	.88	.498	.00154	86.0	.0148	93.5
Average	2.94	1.54	.94	1.24	.640	.00161	91.2	.0147	95.2

TABLE III.—FINAL TEST TO DETERMINE FRICTION COEFFICIENT.

30 Year Old Cast Iron Sewer

(With Equal Depths of Flow at Upstream and Downstream Gaging Stations)

(Length 1,497 Feet) (Slope of Invert 0.121%)

	Velocity based on *mean* time of appearance of color (ft./sec.)	Depth of Flow—At Upstream M.H. (feet)	Depth of Flow—At Downstream M.H. (feet)	Average depth (feet)	Hydraulic Radius	Slope per foot	Friction Coefficients—Chezy "C"	Kutter's "n"	W.-Hazen "C"
1	2.60	1.32	1.52	1.42	.725	.00107	93.6	.0149	97.0
2	2.72	1.51	1.69	1.60	.780	.00109	93.5	.0150	95.5
3	2.74	1.40	1.33	1.37	.705	.00126	92.1	.0150	95.5
4	2.98	1.68	1.61	1.64	.791	.00126	94.4	.0150	96.0
Average	2.76	1.48	1.54	1.51	.750	.00117	93.4	.0150	96.0

Fig. 2.—Another Interior View of the 36-in. Cast Iron Sewer in 1933. Note Clean Walls Above the Flow Line and Grease and Slime Below It. Some Pitting from Acid Production Within the Slime Was Observed in the Zone of High to Mean Flow Levels.

purposes of comparison, the coefficient and relative capacity if a smooth protective lining had been applied to the pipe:

	Kutter's "n"	Chezy "C"	Williams-Hazen "C"	Capacity M.G.D.	Relative Capacity
New line (assumed W-H "C" = 120)	0.0125	116.5	*120*	15.95	123.5
Present values after 30 years' service	0.0150	93.4	96	12.90	100.
With smooth pipe lining (assumed)	0.0090	146.0	*150*	20.00	155.

In the consideration of the question of the value of providing a lining in cast iron pipe for sewer purposes, it is of interest to compare the reduction of carrying capacity in this sewer with the average rate of reduction in cast iron water mains, as given in the Hazen-Williams tables.

In the sewer line in question, the coefficient was reduced to 96 in thirty years, whereas the average estimated value in a water main, under average conditions for a similar period of life, is "C" = 90. Accordingly, in this instance the reduction in capacity was slightly less than is normally anticipated in water supply lines.

On the other hand, with a smooth pipe lining, the initial capacity would be approximately 25 per cent higher than with a pipe provided only with the ordinary tar dip. With a smooth lining the pipe would also have 55 per cent greater capacity than was found in the pipe line tested after thirty years' service.

With the relative assurance of permanent high coefficients with linings now available, the use of a lining would always be justified, for the additional cost of the most expensive lining represents but a small portion of the value of the additional capacity thereby obtained.

Reservoir Long Time Filling

Cambridge, Ohio, built a storage reservoir for its water supply 18 years ago, and it was filled for the first time in April this year, due to the untiring efforts of Mr. Walter Turner, superintendent of water works, states the May 15 issue of Ohio Health News.

The reservoir is formed by a dam across a rather deep ravine about two miles east of Cambridge. Water flows into it from a very small drainage basin. This constitutes only a small portion of the supply, the main portion of which is derived from Wills Creek. Water is pumped from the creek into the reservoir, whence it flows by gravity into the purification plant. The flow of the creek is so low during certain seasonal periods that storage in the reservoir is necessary to maintain a sufficient supply.

Immediately after construction of the reservoir it was found that considerable water leaked around the dam through fissures in the rock *strata.* Leakage was so great that only a small portion of the reservoir capacity could be utilized, although the amount was sufficient for the city's needs for any except periods of drought conditions.

Mr. Turner, as city engineer, later as director of public service, and finally as superintendent of water works, has given much time to the task of stopping the leaks. A tunnel was driven into the hillside, and fissures in the rocks were filled with concrete. It was only lately that the last fissure was found and stopped by this means. It is said that more than a carload of cement has been poured into these fissures, mostly small and nearly always hidden, so that the only way to find them was by extending the tunnel. To one with less determination it would have seemed like a hopeless task.

The reservoir now registers a high-water mark at approximately 170 million gallons.

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National Cast Iron Pipe Company Offers Super De Lavaud Pipe

A recent letter from Paul A. Ivy, Vice-Pres., National Cast Iron Pipe Company, announces that this company now manufactures pipe produced by the Super De Lavaud process which markedly increases impact resistance of centrifugally cast pipe and thereby practically eliminates the damage hazard involved in loading and handling cast iron pipe. A new catalog which gives detailed information and data on pipe produced by the Super De Lavaud process is available upon request to the National Cast Iron Pipe Co., Birmingham, Ala., or Jas. B. Clow & Sons, Chicago, Ill.

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D'Esposito Project Engineer for Chicago Sanitary District Work

Joshua D'Esposito, heretofore public works state engineer for Illinois, has been appointed a resident project engineer of public works on the $42,000,000 Chicago sanitary district PWA construction job, Secretary of the Interior Ickes also has announced the appointment of C. M. Osburn, former city manager of several Wisconsin towns, to replace Mr. D.'Esposito as state engineer.

Administrator Ickes announced that the services of the special board of engineers appointed by PWA as consultants on the sanitary district project would be made available as needed to Mr. D'Esposito. This board is composed of Brig.-Gen. C. W. Kutz, retired; Daniel W. Mead of the University of Wisconsin and W. B. Storey, former president of the Santa Fe railroad,

MEETING OF THE NEW ENGLAND SEWAGE WORKS ASSOCIATION

THE New England Sewage Works Association held its spring meeting at the Pickwick Arms Hotel in fashionable Greenwich, Conn., on April 30th. A registration of 137 (attendance exceeding 150) constituted the largest of any meeting of the Association.

The morning session was devoted to technical papers and a brief business session at which Secretary-Treasurer F. W. Gilcreas reported on the very satisfactory growth of the Association and its strong financial condition. Officers for the year being named only at the Fall meeting, there was no election.

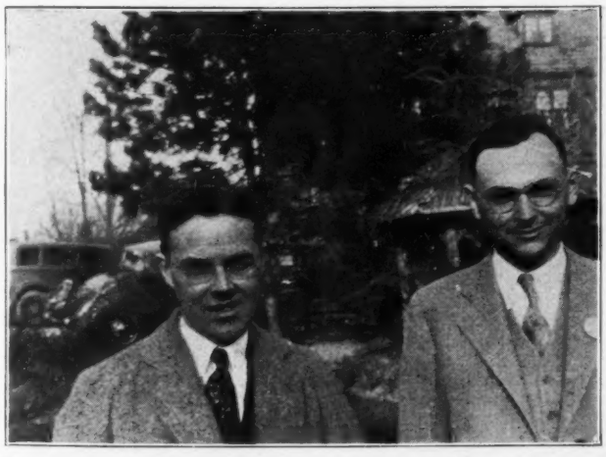
At luncheon W. J. Willson, chairman of the Greenwich Sewerage Commission, made a brief address in which he commented on the sewerage facilities of Greenwich and its future program. The Round Table Discussion and the always valuable Question Box (reported below) followed luncheon. In the afternoon the three Greenwich sewage treatment plants were inspected.

Who Was Lemuel Shattuck?

At the dinner, Dr. A. E. Austin, health officer of Greenwich, made a short address of welcome.

As the speaker of the evening, Professor Earle B. Phelps of Columbia University—himself a pioneer in sanitation—revealed to many for the first time the contributions to public health work made by a little known man—Lemuel Shattuck—"A New England Pioneer in Sanitation." Professor Phelps' "hero" had been unsung in New England sewerage circles apparently because the title of the address on the program elicited the question from many—"Who was Lemuel Shattuck?"

Without attempting to do justice to Professor Phelps' excellent presentation in unfolding the career and life work of the far-sighted Lemuel Shattuck, we present just a few highlights of interest. Starting as an obscure school teacher in Massachusetts, Lemuel Shattuck in 1845 became interested in the census and, later, the birth and death rates in cities, villages and rural sections. He improved the method of taking the census; noticed the very high death rates (22 per 1,000) in congested areas of Boston as compared to the much lower rates in Newton and other nearby points; was successful in getting appointed a Sanitary Commission (1849), on which he served as a member. Out of this came the sanitary survey followed by a report with recommendations to the Governor (1850) which outlined the need of what later was organized in Massachusetts as the first State Board of Health. The Shattuck pioneering doctrine was that of spending public monies for prevention of diseases, in order that the high cost of this public liability might be reduced. The detail of Shattuck's recommendations were remarkable and so clearly put that many of them were adopted in the formation and undertakings of the State Board of Health some 20 years later.



Warren J. Scott, Chief Engineer, and Leroy Van Kleeck, Assistant Engineer, State Department of Health, Hartford, Conn.

The New Plant Located at Old Greenwich, Conn. End of Settling Tanks and Sludge Pump House Show in Center.

Technical Sessions

(President, J. W. Bugbee—Presiding.)

"The Chlorine Disinfection of Sewages"—W. J. Scott, Chief Engineer, and LeRoy W. Van Kleeck, Assistant Engineer, State Department of Health, Hartford, Conn.

Studies of bacteriological results at several treatment plants at which chlorination is practiced led the authors to advocate the use of thiosulphate to neutralize residual chlorine in sewage samples at the time of collection if the true picture of disinfection efficiencies was to be had. The contact period being extended between the chlorine and sewage during transportation to the laboratory had been shown to give apparent results not realized in actual practice where much shorter contact periods were available between the chlorination point and that of discharge of the treated sewage to the receiving water course. Carefully controlled studies had shown a 5-minute contact period, in practice, to be too short. Examination of disinfection results seemed to indicate the need of 0.5 p.p.m. residual chlorine and a contact period of 15 minutes or 0.2 p.p.m. residual after a period of 30 minutes—not less than 0.5 p.p.m. residual being recommended, however, in either instance.

Salt water entering sewers laid in marshy areas had caused production of hydrogen sulphide at temperatures above 72 deg. F. and raised chlorine demands perceptibly thereby. In studying chlorine demands at sedimentation plants, the comparison between the requirements in pre-chlorination vs. post-chlorination and resulted in revealing the outstanding value of pre-chlorination as a summer practice. Best practice, however, would constitute making provision for pre- or post-chlorination at will. Es-

pecial reference was made to the results from pre- vs. post-chlorination at the Stamford, Conn., Imhoff tank plant. The full value of pre-chlorination, according to the authors, might require days or weeks before the ultimate benefits are realized in full. They had found solution feed chlorination preferable to direct feed, by far, and considered deep baffles in flowing through (sedimentation) chambers to be a hindrance to the best efficiences of tanks and the effectiveness of pre-chlorination. They

Julius W. Bugbee, Superintendent of Sewage Treatment, Providence, R. I., is President of the Association.

F. W. Gilcreas, Secretary of the Association.

counselled against locating chlorination stations above sewage tanks or contact chambers because of the damaging effects of moisture and sulphide gases escaping into the room. Further, long runs of chlorine solution line should be avoided. Chlorine economy could be had by controlling the dosage so as to avoid waste of over-chlorination by resetting the machines at intervals during the day in order to take advantage of the reduced chlorine requirement of decreasing volumes and strengths of sewage. In many instances a routine schedule of change in dosages could be evolved to meet seasonal requirements—more in summer; less in winter.

A practical and convincing demonstration of the effectiveness of controlled sewage chlorination had been had in the studies made of harbor and shell-fish growing waters receiving settled chlorinated effluent. In the case cited, residual chlorine was obtained with a 5.5 p.p.m. (average) dosage. Of 349 samples examined from the oyster area during chlorination, only 8 per cent had been coli bearing whereas prior to chlorination tests had revealed b. coli present in 47 per cent of the 240 samples. More to the point was the effect on the oyster proper, found highly contaminated before chlorination but had absolutely safe scores (in b. coli content) following the introduction of sewage chlorination.

L. H. Enslow, speaking as Engineer of the Chlorine Institute, said that he was pleased to learn that the Connecticut authorities had become convinced of the advantages of pre-chlorination as a valuable, economical and dependable practice. The high value of the long contact period available through pre-chlorination was an important consideration and led to chlorine economy and much higher protection. He referred to the earlier studies at Bridgeport, Conn., and Huntington, L. I., which had confirmed the recommendation of the authors that bacterial samples be de-chlorinated with thiosulphate at the instant of collection—an excess of the anti-chlor being unobjectionable. At Stamford, Conn., there was some question as to the most satisfactory point of pre-chlorination until a trial up sewer vs. application immediately ahead of the plant had revealed the latter point to give superior results. Ordinarily the point further removed from the plant would have been automatically selected but local conditions (infiltration just ahead of the plant) had altered an earlier opinion based on a study of a map of the sewer system. The case had represented another illustration that rules in chlorination practice are frequently altered by the case and each situation requires individual considerations. The trials at Stamford had brought the city a considerable saving in construction and operating expense.

Mr. Enslow pointed out the practicability of pre-chlorination in all cases save those in which septic tanks were involved. In such there was no economy from pre-chlorination and the contact of sewage with the sludge and scum caused it to again become coli laden before it reached the tank outlet. Carrying residual chlorine through a septic tank was not practical.

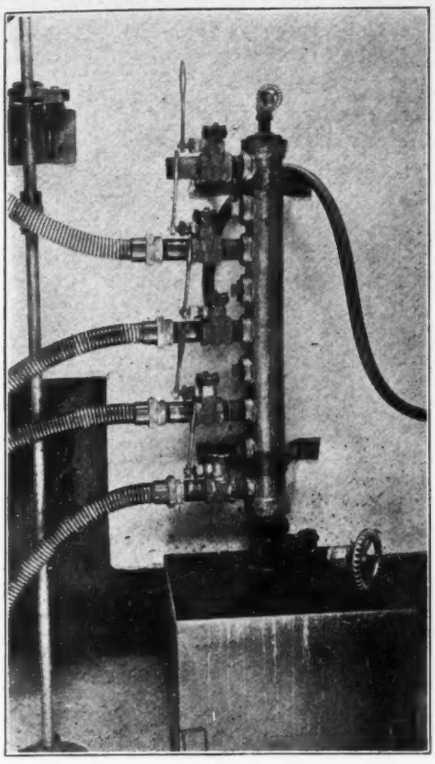
Professor Earle B. Phelps, the earliest American investigator of sewage chlorination, recited some of his experiences with the process in 1908 when he was able to predict the value of pre-chlorination. More recently he had had interesting experiences in shell fish protection by sewage chlorination. He emphasized the rapidity with which the process had proved effective in clearing up the bacterial pollution of the affected waters—the ultimate effect being reached within the first 10 days of application. Returning to the subject of pre-chlorination, he was of the opinion that "split" chlorination or "cumulative" chlorination, procured by employing perhaps several points of application, would be overall the most efficient process from the standpoint of effective disinfection and preservation of the freshness of sewages.

Dr. W. Rudolfs added that pre-chlorination often afforded a more effective, thorough and spontaneous distribution of chlorine then did post-chlorination. That, being conducive to improved bacterial efficiencies and reduction of chlorine consumed, had a particular value. Further, the long contact period obtained by pre-chlorinating was of high importance.

Guy E. Griffin, Engineer in Charge of Sewage Works, Greenwich, Conn.

Paul Martzell, Chief Operator, Grass Island Plant, Greenwich, Conn. Troubled with "slime" growth in his sewers; tried putting "some chemists down the sewer—didn't do much good."

The question of the effect of pre-chlorination on the activated sludge process was raised by a member. The reply was that an excess of residual chlorine reaching the aeration tanks was eventually detrimental. Controlled chlorination, to prevent such, had proven that pre-chlorination was non-injurious and in instances decidedly helpful in that the sewage would reach the plant in fresh or perhaps a less septic condition—a matter of some consequence to the activated sludge process. A member pointed out the practical use of bleaching powder

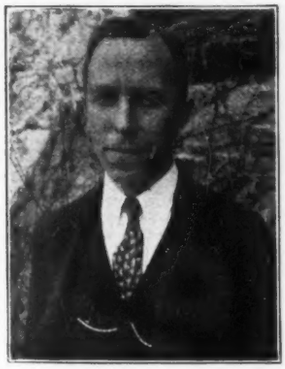


Sludge Sampling Arrangement at Old Greenwich Treatment Plant. Flexible Copper Tubing Connect Manifold to Various Tank Depths. Quick Opening Valves Facilitate Sampling and Observation of Sludge or Supernatent Liquor Quality.

(chlorinated lime) applied to returned sludge or aeration tanks in which the sludge had started to show signs ot becoming septic. Following this drastic treatment, the sludge had returned again to a "healthy" condition in the aeration units in due time.

"Recent Developments in Sewage Treatment in Germany and Belgium"—Dr. W. Rudolfs, Chief, Department of Sewage Research, N. J. Agricultural Experimental Station, New Brunswick, N. J.

Dr. Rudolfs in his introductory remarks said that he objected to statements made to the effect that streams in



S. M. Ellsworth, Consulting Engineer of Boston, who acted as Resident Engineer for Metcalf & Eddy during construction of the Old Greenwich plant.

Prof. Earl B. Phelps, Columbia University.

Germany exhibits little signs of pollution considering the loadings placed on them. Maybe not, he said, from the railroad car windows but his differing opinion was based on closer examination. One interesting thing, different from conditions in America, was the open sewers of Germany which kept the sewage fresh. In other instances acid mine wastes containing iron served to preserve the sewage while enroute to treatment works.

In Germany, as in England, floating covers on digestion tanks were not new; dated back to 1912; consisted of concrete slab covers. The earliest heated digestion tank was that of Dr. Fries to which hot water was directly added to the sludge. The newest digestion tanks were heated with coils, were very large units, had conical shaped tops and bottoms, had mixing devices (Pruss Pumps) and had been designed by Dr. Pruss and built at Essen-Nord in the Emscher District of which he is Chief Engineer.

In the Ruhr District of which Dr. Imhoff is Chief Engineer the most interesting development had been the full utilization of natural purification processes provided by a series of artificial lakes on the streams of the District. Sewage treatment was thereby confined to primary treatment, the lakes serving as secondary devices to complete the purification. Lower lakes in the series were being devoted to recreational use. The series of 3 lakes now on the Ruhr have brought a marked improvement, thus reclaiming the stream for the extensive recreational development. The iron bearing mine water seemed to be an effective germicide, coagulation and clarification taking place in the upper pond. The whole scheme of

Group Inspecting the Grass Island Plant at Greenwich.

the Ruhr development seemed complete, its upper lakes used for water supply and control of dilution. When there were lakes into which water is pumped during the night for draining down to produce higher priced (day) power in the high demand periods; finally, lakes for clarification and self purification of settled sewages and the lowest lakes for pleasure usage (bathing, fishing, boating) at a cost of but 1 mark per capita per year for maintenance of such lakes.*

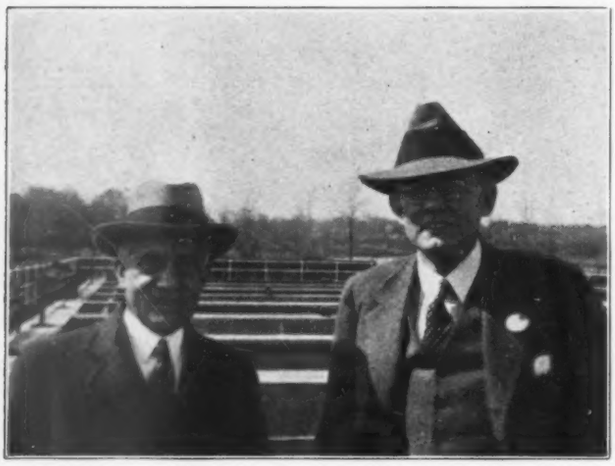
In sewage treatment, an interesting large scale (plant) demonstration at Soest in the Lipper District reverses the Birmingham, England, scheme of preceding sprinkling filters by partial activated sludge treatment. At Soest filters, with revolving distributors, are used as "shock troops." The decolloidized and partly oxidized effluent (containing filter unloadings) is put through the activated sludge process with gratifying results.

Under Dr. Blunk's direction (Emscher District) an experiment, in which air forced upward through a closed

*All of which makes one wonder why American practice might not profitably follow a similar stream reclamation pattern on such watersheds as the Trinity, from Fort Worth to below Dallas, Texas; the upper Mississippi below St. Paul and Minneapolis and on others subject to drought, flood and pollution.—*Editor.*

sprinkling filter, had apparently made it possible to apply three times the ordinary loading to the unit; with heated air in Winter 7 times the loading. (Seems to bear out Russian demonstrations involving forced draught filters—Editor.)

One plant is successfully treating dairy waste by activated sludge, Kessner's revolving brushes being used as aerating devices. A plant treating phenol wastes by the activated sludge process functions but requires 36 cu. ft. of air per gallon. At Knocke, Belgium, a scheme



A. L. Falcs and E. Sherman Chase, of Metcalf & Eddy, Engineers, Boston, Mass. The latter is President of the New England Water Works Assn., which met in Greenwich the day following this meeting.

of disposing of supernatant digestor liquor involves aeration followed by activated sludge primary treatment thence to sprinkling filter units.

Dr. Rudolfs said that the value of agitation of digestion tanks to suppress scum formation had been forcefully demonstrated to him at one point at which an accumulated 1 foot scum blanket had been dissipated in a few minutes.

Dr. Rudolfs also put humor into his interesting illustrated review by telling of the activated sludge plant operated by a priest and a plumber. The former, tiring of going to the plant daily to see if the compressor was operating, installed a tell-tale flag which could be seen waving from his room-window as long as the machinery operated. The plumber, not to be outdone, put grease cups on the mechanical equipment which required but one trip a week to the plant for greasing.

Dr. Rudolfs was critical of the rather mediocre operating and analytical data kept by operators of German sewage treatment works.

Greenwich Plants Described and Inspected

"Sewage Treatment in Greenwich, Conn."—GUY E. GRIFFIN, Engineer in Charge of Sewage Treatment, Greenwich, Conn.

Mr. Griffin briefly described the four sewage treatment plants serving Greenwich. Items of interest pertaining to design and operation included the following.

At the Cos Cobb plant, lack of space necessitated construction of glass covered sludge beds on the roof of the 5 septic tanks. At the East Port Chester plant (septic tanks) prechlorination, starting with clean tanks was satisfactory, but became impractical because gradual sludge accumulation and liquifaction produced gradually rising chlorine demands. Prechlorination at Old Greenwich—the newest of the plants—had reduced chlorination costs, reduced rising sludge during operation of the mechanical scrapers, improved odors. One-ton chlorine containers had displaced 150 lb. cylinders at all plants with resulting simplified operation and further economy —viz.—reduced the cost of chlorination by 59 per cent.

In the laboratory an Electrolux refrigerator had been operating for a year on sludge gas at an appreciable saving.*

Mr. Griffin described the newest of the Greenwich plants, (Old Greenwich Plant) somewhat in detail. This plant, designed by the firm of Metcalf and Eddy, being located in an area of high class residences, required careful planning. To prevent complaints the design incorporated covered settling tanks with mechanical sludge removal at frequent intervals, glass covered sludge beds, prechlorination, gas burning and other details to make first class operation possible. Equipment included Link Belt Sludge mechanism, Rex (Chain Belt) sludge pumps, Downes' Floating Covers on digestion tanks, American Moninger glass covers on sludge beds, Wallace and Tiernan chlorinators, Bailey flow recorders, recording thermometers. The flexible copper tube sludge sampling arrangement was unique and helpful. An observation and sampling arrangement for taking fresh sludge, during pumping, had proved a valuable accessory.

The scraper mechanism was operated only 1 hour daily just prior to sludge pumping to the heated digesters. An ⅛-inch wire mesh screen on outlet wires was helpful in holding back solids, gas lifted solids appearing following scraping operations. Digestion temperature of 80 to 83 deg. F. seemed to afford best operation of digesters and gas production yields of 0.5 to 0.7 cu. ft. per capita had been the average at normal pH of 6.8 to 6.9 within the digesters—no lime being used. Digested sludge averaged 7 per cent solids (50 per cent volatil), dried in 7 to 10 days when 4 inch depth was applied to the glass covered beds. Lime additions to the digesters had not been beneficial. Moisture in the gas lines had frozen,

Guy E. Griffin, explaining the Company's Cobh Plant to the Visitors. In centers Robert Spurr Weston notes something of interest told him by H. B. Allen of South Fitchburg, Mass., on his right.

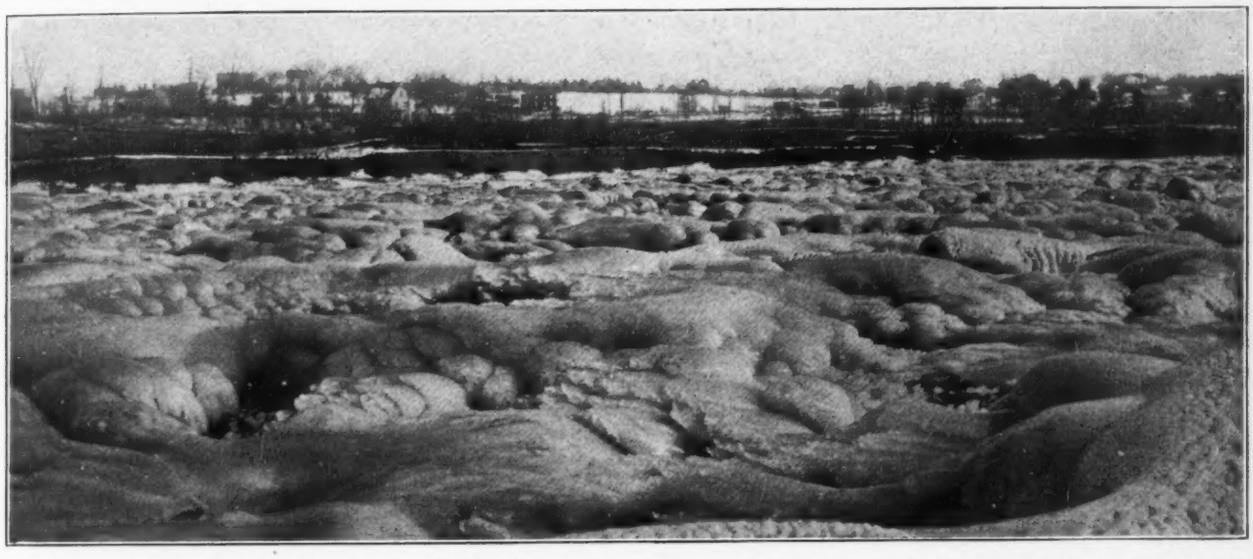
giving trouble until trying the expedient of introducing salt into exposed sections. Hydrogen sulphide in the gas was rather high thereby creating some difficulties. Residual chlorine was carried entirely through the settling tanks which during summer operation produced beneficial effects, including supression of gas lifting of solids. Supernatant liquor from the digesters was passed through the old septic tank, thence to the crude sewage.

E. SHERMAN CHASE, of Metcalf and Eddy, Engrs., Boston, Mass., in discussion, complimented Mr. Griffin

*For a description of this refrigeration unit and the simple changes required to the ordinary burner of an Electorlux, when using sludge gas—see Mr. Griffin's article on page 426 of the December, 1933, issue of WATER WORKS AND SEWERAGE.—*Editor.*

on the appearance and operation of the Greenwich plants. Of particular interest was the fact that the sedimentation-digestion plant had been operated free from nuisance to its nearby neighbors across the street. Infiltration of sea water containing sulphates had constituted a potential source of odors from hydrogen sulphide.

S. M. ELLSWORTH, Consulting Engineer, Boston, Mass., who as Resident Engineer had supervised construction of the plant, said that long narrow settling tanks had been selected because of the economy of construction of the required roof. The tanks had been located beneath the lawn with the idea of hiding the sewage and crude solids as much as possible and also to confine possibly odorous gases. The Clifford type tank inlets had been provided to still the sewage by throwing it against the wall across the inlet end of the tank—this also being the sludge outlet end. He believed the sludge sampling equipment installed to be novel and an important operating device.—See accompanying illustration.



Cold Weather Troubles at Fitchburg, Mass. Believe It or Not! These are Fitchburg's Sprinkling Filters as they looked in February, 1934.

A. SLAVIN, Clyde Potts Engineers, New York City, told of the unique features of the Cos-Cob plant, necessitated by ground conditions and land area limitations.

W. J. WILLSON, Chairman, Greenwich Sewer Commission, explained several of the shortcomings found to exist in the older treatment plants and sewer design in Greenwich. He warned engineers against the installation of non-flexible outfall lines (flanged pipe) and condemned inaccessible locations of crude sewage pumps difficult to clean. Inadequate drainage of sludge beds had also added to troubles which he had found to exist when assuming charge of the local sewerage system.

WARREN J. SCOTT took occasion to compliment the Sewerage Commission and the operating staff for its program and quality of maintenance and operation.

Winter Operating Troubles Discussed at Luncheon

An important topic of the Round Table Discussion was that of "Winter Operating Troubles."

ROY S. LANPHEAR, Superintendent of the Worcester, Mass., plant reported considerable difficulty with sluice gates freezing. Screenings froze on the mechanically raked bar screens. Sprinkling filter nozzles had to be eventually removed. At first, removal of the end nozzles was sufficient in January but later (February) with the sustained cold of 4 deg. above zero as the average daily minima, all nozzles had to be removed. Ice formed on the filters to a depth of 13 inches and grease scum on the Imhoff tanks froze solid. Stability of the filter effluent had dropped to 3 days, oxygen saturation to 25 per cent, and nitrates to 2 to 3 p.p.m. Filter ponding was in evidence now but was gradually clearing up.

H. B. ALLEN, Superintendent of the Fitchburg, Mass., plant reported a unique experience in ice formation on sprinkling filters. With a mean minimum temperature of 15 deg. below zero during the period Jan. 29th-Feb. 10th, 8 to 10 men had been kept busy on the filter nozzles. Nitrates had dropped to 2.5 p.p.m. in the effluent as against 5 to 14 p.p.m. normally. Ordinarily the ice formation on sewage filters was of a spongy structure but he had noticed a change to very solid structure the past winter. Seeking the cause, it was found that the bleeding of water through household fixtures to prevent freezing had resulted in a high dilution of the sewage. Reaching the plant with the lowest temperature (34 deg. F.) ever recorded for crude sewage, it froze quickly and solidly. What the Fitchburg filters looked like as a result, the accompanying picture reveals.

Putting "Chemists" Down Sewers

In the "Question Box"—there was a request for suggestions of schemes of eradicating slime growths from sewers.

P. MARTZELL, Chief Operator, Grass Island Plant, Greenwich, raised a laugh when he said that he had already put "some chemists" down the sewer but "they hadn't done much good." Professor Fair, in reply, thought he might try the "chemists" again—feeling that copper sulphate or chlorine would do the job.

The old, old question—"How can one tell when sludge is digested—especially activated sludge" was propounded.

A. L. FALES, asked by the chair to answer, said that the ordinary test of odor and drainability was the surest. The content of volatil matter was the basic criterion—a sludge with its solid content 50 per cent volatil would dry twice as rapidly as another with 10 per cent more (60 per cent) volatil, i.e., 10 days for the first and 20 days for the sludge carrying 60 per cent volatil matter.

At New Caanan, Conn., C. F. PROUDMAN reported that he was drawing sludge with 70 per cent volatil; drying time required, 21 days under glass.

Inspection of three of the Greenwich plants occupied the remainder of the afternoon following adjournment.

EDITORIALS

Shall We Be Drifting or Driving?

We have extended to the incoming President of the American Water Works Association an invitation to make use of the editorial page of this Water Works Association Convention issue. We are pleased to present his message to the Association at large, and to all who are engaged in water-works activities throughout the country.—Editor.

DEEPLY sensible, as I am, of the honor which the American Water Works Association has conferred upon me in choosing me to be its next president, I should be unworthy of that honor if I failed to express my hopes for better things from the Association.

The Association has a splendid record. When the twenty men from the middle west met at St. Louis in 1881 and set up the organization, North America was definitely upon the path leading away from an agrarian and toward an urban dominance. But cities live and prosper not alone upon the products of agriculture, but just in so far as they perfect the environment of their own population. We have passed through the "herb-doctor" stage of mid century agriculture and the "patent medicine" stage of the gay eighties and nineties of the last century to "engineering of the environment" stage of the twenties and thirties of the present century. In that transition, we have witnessed the contribution that public water supply organization and improvements have made. From the days when public water supplies were available intermittently, and then but little or not at all purified, we have gone forward to the time when the demands for fire protection are met by continuous and adequate service; and, sanitary quality of such supplies is of proven dependability as evidenced by the practical disappearance of water borne disease and the conformance of practically all supplies to the increasingly rigid requirements of the U. S. Public Health Service.

In this progress, the organization and contacts afforded by the American Water Works Association have been valuable contributory factors. The Association has grown in prestige. Its present president, Malcolm Pirnie, has done the people of the United States a great service by his active association with the National Recovery Administration. Due to his activity and those associated with him, urban sanitary works—water supply, sewerage collection and sewage disposal—have been placed in a preferred position in respect to other public works projects, subject to government aid. That is admirable. But I am sure that not enough of the men in responsible positions in water supply works have been supporting him and the association which he leads.

There are almost 11,000 water works plants in the United States and doubtless several thousand more in the rest of North America. But the largest number of members the Association ever had was less than 2,900 and there were less than 2,300 at the end of 1933.

Why is it that an association doing the fine work that this one is, the only one internationally representative of North American Water Works men, is so inadequately supported? The answer is, in my opinion, because water works men suffer severely by reason of being a part of a minor phase of municipal administration in North America. Arthur Morgan has recently warned us that we shall never correct this deficiency until we recognize the fact (and practice it) that the political and administrative functions of government cannot be viewed in the same category. However much, and ill or well advisedly, we may assume that short tenure of office is desirable for political office holders, we certainly cannot justify by any rational consideration the idea that men in administrative or public service functions of municipal government should also be subject to short tenure of service. By the same line of thought we must conclude that the service departments need to develop some technic of grading that will weed out the incompetents.

It is a rare city that does not hamstring its water department if one nationally labeled party overturns the rule of another; and, it is a still rarer municipality that has some method of appraising the value of the services that a person renders the department. The majority of cities fail to separate their water department activities from the general municipal activities. Fewer cities are fortunate enough to have a water board that is permitted either by law or by practice to handle the departmental affairs as a business.

The result of all these factors is to reduce the personnel of many water departments to a short term and uncertain basis so that they do not have an opportunity to become "water supply-professionally" minded. If city dwellers in the United States wish better water service, if the men in the water departments want to give better water service, the one great forward step to take promptly is that of putting plants on a business basis and divorce them from political domination or interference.

Many people have been hopeful that a code of the water supply industry might be adopted. The real service that such a code might bring about should be the setting up of standards of departmental management and improvement in performance of personnel. This no other force has yet been able to do for water plants in the United States. Water works men need state and national unity. The old "home rule" idea in municipal administration has been the "home ruin" of many Water Departments.

The various sections and the international organization of the American Water Works Association offer the water works man the opportunity to unite with other men in the same field in his own interest and in the interest of good service. Shall water supply men be drifters or drivers?

Harry E. Jordan

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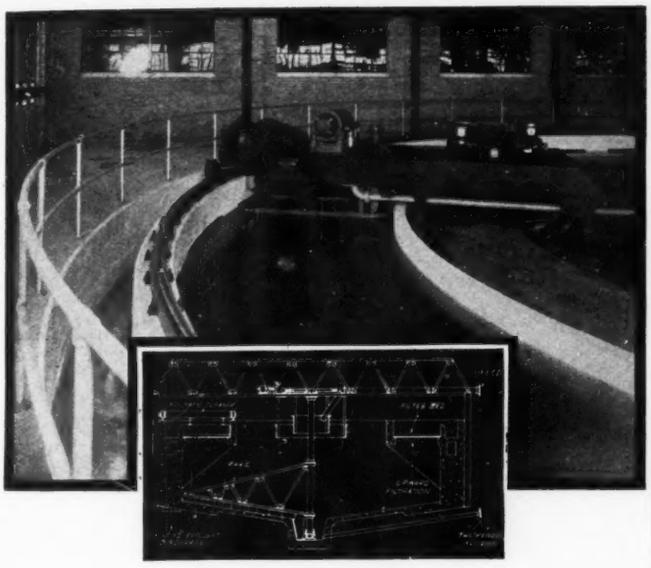

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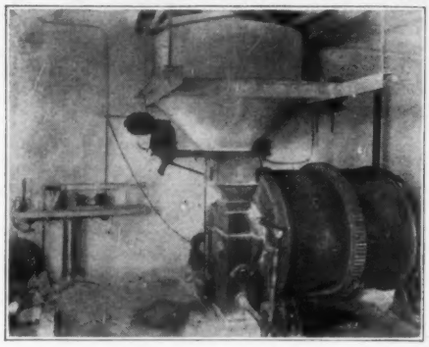

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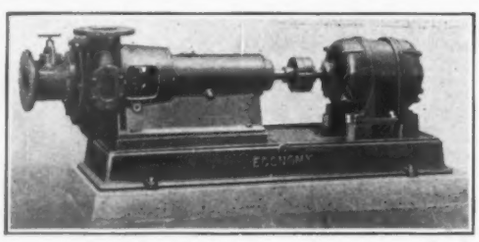

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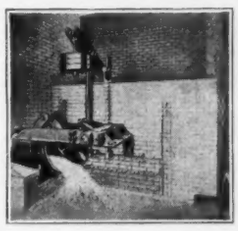

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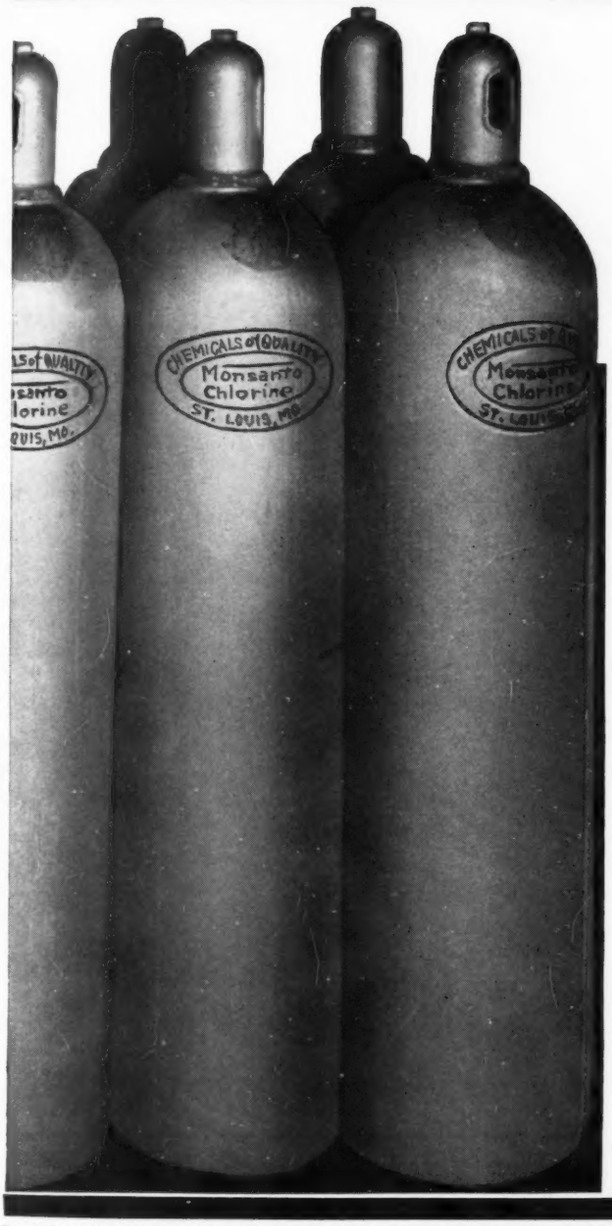

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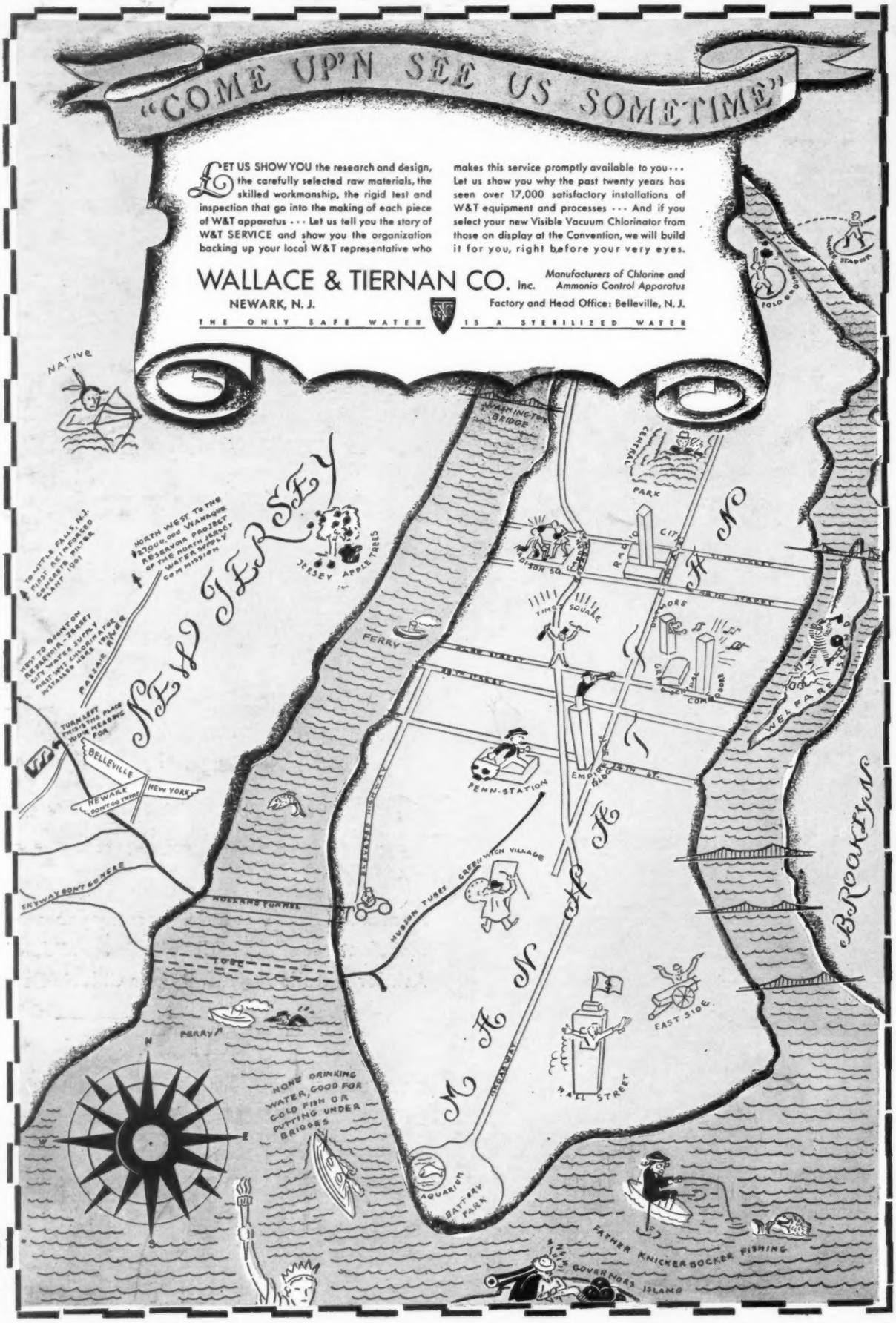
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